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USER'S MANUAL
AEROTHERM CHARRING MATERIAL THERMAL RESPONSE AND ABLATION PROGRAM
VERSION 3

Volume II – Fortran Variable Names, Flow Charts, and Listings

April 1970

Air Force Rocket Propulsion Laboratory
Director of Laboratories
Edwards, California 93523
Air Force Systems Command
United States Air Force

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Volume II - Fortran Variable Names, Flow Charts, and Listings

Prepared Under
the Sponsorship of

Air Force Rocket Propulsion Laboratory
Director of Laboratories
Edwards, California 93523
Air Force Systems Command
United States Air Force

Project Officer, Robert J. Schoner/RPMCH

FOREWORD

This report is one of two computer program user's manuals prepared by Aerotherm Corporation under USAF Contract F04611-70-C-0012. Included herein is Volume II of the manual for Version 3 of the Aerotherm Charring Material Ablation code. This volume presents definitions of Fortran variables, flow charts, and program listings. The report was first published as Aerotherm Report No. UM-70-14. The work was administered under the direction of the Air Force Rocket Propulsion Laboratory, Motor Component Development Branch with Mr. R. J. Schoner as project officer.

Mr. M. R. Wool was program manager and principal investigator. Significant additional assistance was also provided by Dr. C. B. Moyer.

This technical report has been reviewed and is approved.

R. J. Schoner
Project Engineer, AFRPL

ABSTRACT

This two-volume report describes a Fortran IV computer code which computes the transient thermal and ablation response of a charring insulation material structure. The program is for one-dimensional bodies, but can treat a variety of shapes, including planes, cylinders, spheres, and more general thermal "stream tube" bodies. The program can treat complex systems including a main ablating material, several charring back-up materials, and a multiple non-charring material back-up structure.

An unusual feature of the code is the very general heated surface boundary conditions, which can account for

- Simple specified temperature and recession rate
- Specified heat flux with no recession
- General thermochemical erosion model incorporating complete chemical erosion computations, both equilibrium and non-equilibrium, for any material exposed to any environment.

The code has seen extensive use for thermal performance studies of ablating heat shields, rocket nozzles, and spacecraft structures.

Volume I of this report contains descriptions of the problem treated, the equations solved, the input information required of the program user, and the program output information. It also provides a card-by-card user's input guide and a number of sample problem input and output listings. Volume II of the report contains supplemental information on the specific Fortran IV codings. It includes program listings, flow charts, and definitions of Fortran variable names.

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SECTION 1

INTRODUCTION

The computer program described in this user's manual is a revised edition of the Aerotherm Charring Material Ablation computer program. The previous code, CMA Version 2, is described in References 1, 2, and 3. The current program, CMA Version 3 (denoted CMA3 or CMA/CBM), solves all problems that earlier versions could solve and provides additional computational capabilities, featuring in particular an added charring back-up material capability.

The purpose of Volume I of this user's manual was to enable an unfamiliar user to utilize effectively Version 3 of the Aerotherm Charring Material Ablation computer program. It contained a general description of the problems that CMA3 solves, an input data deck preparation guide, and sample problem input and output. Volume II of this manual, included herein, contains the following additional program documentation:

- Definitions for important Fortran variables used
- Flow charts of program logic for each Fortran routine
- Listings of Fortran IV source decks

These are given in Sections 2, 3, and 4, respectively. Another document of potential value to a reader desiring a more detailed exposition of the theoretical fundamentals of the CMA program is Reference 4.

SECTION 2

FORTRAN VARIABLE NAMES

The names and definitions of all Fortran variables used in important subroutines in Version 3 of the Aerotherm Charring Material Ablation code are given in this section. Since the CMA3 code is divided into several routines, the majority of all variables are included in COMMON statements. These variables are defined first. Fortran variables which are used only locally in the CBM, INPØUT, and THERMS subroutines are then defined. Variables used locally in minor subroutines are not given.

LIST OF FORTRAN VARIABLES
APPEARING IN COMMON STATEMENTS

VARIABLE NAME	DESCRIPTION	UNITS
AREA ( )	ORIGINAL (INPUT) CROSS SECTION AREA OF NODE	FT2
ASTER	1H*	
BA	ARRHENIUS PRE-EXPONENTIAL FACTOR IN DECOMPOSITION KINETIC EQUATION FOR COMPONENT A	SEC-1
BB	ARRHENIUS PRE-EXPONENTIAL FACTOR IN DECOMPOSITION KINETIC EQUATION FOR COMPONENT B	SEC-1
BBB(I,J)	ARRENIUS PRE-EXPONENTIAL FACTOR IN DECOMPOSITION KINETIC EQUATION OF J TH COMPONENT OF I TH DECOMPOSING BACK-UP (ANALOGOUS TO BA, BB, BC)	SEC-1
BC	ARRHENIUS PRE-EXPONENTIAL FACTOR IN DECOMPOSITION KINETIC EQUATION FOR COMPONENT C	SEC-1
BLANK	1H	
BREX	INPUT BURNING RATE EXPONENT USED IN MODIFYING INPUT TRANSFER COEFFICIENT	
BRP	BLOWING REDUCTION PARAMETER, LAMBDA	
CHCRI	CHAR INTERFACE CRITERIA: CHAR LINE DEPTH IS DEPTH OF LINE OF DENSITY RHO(2)+CHCRI*(RHO(1)-RHO(2))	
CMH	RATIO OF CM/CH	
DEL( )	NODE THICKNESS	FT
DELHG	ENTHALPY OF FORMATION OF PYROLYSIS GASES	BTU/LB
DELM	MINIMUM ALLOWED THICKNESS OF LAST (SHRINKING) NODE IN ABLATING MATERIAL	FT
DEN	INTERPOLATION FRACTION FOR FUNCTIONS-OF-TIME TABLES	
DHC(I)	ENTHALPY OF FORMATION OF CHAR OF I TH DECOMPOSING BACK-UP (ANALOGOUS TO DH2)	BTU/LB
DHV(I)	ENTHALPY OF FORMATION OF VIRGIN PLASTIC OF I TH DECOMPOSING BACK-UP (ANALOGOUS TO DH1)	BTU/LB
DH1	ENTHALPY OF FORMATION OF VIRGIN PLASTIC, MAIN MATERIAL	BTU/LB

LIST OF FORTRAN VARIABLES
APPEARING IN COMMON STATEMENTS

VARIABLE NAME	DESCRIPTION	UNITS
DH2	ENTHALPY OF FORMATION OF CHAR, MAIN MATERIAL	BTU/LB
DTMB	LIMIT VALUE OF TIME INCREMENT	SEC
DTMIN	INITIAL TIME STEP USED AT BEGINNING OF PROBLEM AND AFTER A CHANGE IN OPTION	SEC
DTPRT	FIRST OUTPUT TIME INTERVAL	SEC
DTPR2	SECOND OUTPUT TIME INTERVAL	SEC
DTPR3	THIRD OUTPUT TIME INTERVAL	SEC
EA	ACTIVATION ENERGY FOR COMPONENT A, EA/R	DEG R
EB	ACTIVATION ENERGY FOR COMPONENT B, EB/R	DEG R
EC	ACTIVATION ENERGY FOR COMPONENT C, EC/R	DEG R
EE(I,J)	ACTIVATION ENERGY E(I,J)/R FOR COMPONENT J OF I TH DECOMPOSING BACK-UP (ANALOGOUS TO EA, EB, EC)	DEG R
EMA( )	SLOPE OF AREA VS ABSOLUTE RADIUS (OR DISTANCE) CURVE OBTAINED FROM ORIGINAL INPUT OF NODAL DATA	FT
EPSW	EMISSIVITY OF BACK WALL	
ETA	NOT CURRENTLY USED	
FF(I,J)	PRECALCULATED COLLECTION OF TERMS IN DECOMP-OSITION KINETIC EQUATION FOR J TH COMPONENT OF I TH DECOMPOSING BACK-UP (ANALOGOUS TO FA, FB, FC)	(LB/FT3)** (1.-PSI(I,J) /SEC
FJFH	HALF THE STANDARD NUMBER OF NODELETS (SEE JF AND FJFS)	
FJFS	STANDARD NUMBER OF NODELETS PER NODE FOR ALL NODES EXCEPT THE FIRST, WHICH HAS HALF THIS MANY	
F1(I,L)	L TH TABULAR F-FUNCTION FOR VIRGIN CONDUCTIVITY IN COMPUTING CONDUCTIVITY IN PARTIALLY PYROLYZED ZONE	
F2(I,L)	L TH TABULAR F- FUNCTION FOR CHAR CONDUCTIVITY, USED IN COMPUTING CONDUCTIVITY IN PARTIALLY PYROLYZED ZONE	
GA(I)	RESIN VOLUME FRACTION FOR I TH DECOMPOSING BACKUP (ANALOGOUS TO GAMA)	FT3 RESIN/ FT3 MATERIAL

LIST OF FORTRAN VARIABLES APPEARING IN COMMON STATEMENTS

VARIABLE NAME	DESCRIPTION	UNITS
GAMA	VOLUME FRACTION OF RESIN (COMPONENTS A AND B) IN UNDECOMPOSED PLASTIC, MAIN MATERIAL	FT3-RESIN/ FT3-MATERIAL
H( )	ENTHALPY AT A NODE	BTU/LB
HCONV	CONVECTIVE HEAT TRANSFER COEFFICIENT AT BACK WALL	BTU/FT2-SEC-DEG F
IDIOT( )	DUMMY EMPTY WORDS IN COMMON	
IEX	NOT USED IN PROGRAM (RETURNED FROM LOOK SUBROUTINE VIA COMMON; SET GREATER THAN UNITY IF EXTRAPOLATION REQUIRED.)	
IHI( )	INDEX OF LAST ENTRY IN A TABLE	
II	OPTION INDEX	
ILO( )	INDEX OF FIRST ENTRY IN A TABLE	
INCH	INPUT TAPE UNIT NUMBER FOR SURFACE EQUILIBRIUM DATA	
INPUT	INPUT TAPE UNIT NUMBER VARIABLE	
IR( )	'REMEMBERED' INDEX IN A GIVEN TABLE ADJACENT TO PREVIOUS VALUE FOR WHICH A LOOK-UP WAS PERFORMED	
ISEN(IPR)	NUMBER OF ENTRIES IN EDGE TABLE FOR INDICATED PRESSURE	
JF	STANDARD NUMBER OF NODELETS PER NODE	
JFH	HALF THE STANDARD NUMBER OF NODELETS PER NODE	
JFHP	JFH + 1	
KHI(I,J)	MARKS LAST ENTRY OF NO-ABLATION (TEMPERATURE INDEPENDENT) PART OF A CHAR RATE TABLE FOR I TH GAS RATE AND J TH PRESSURE (REGARDLESS OF USERS ORIGINAL INTENTION, THIS IS TAKEN AS LAST TEMPERATURE BEFORE TEMPERATURE ENTRIES BEGIN TO DESCEND, IF EVER. THIS EXTENSION SMOOTHS INTERPOLATION.)	
KOUT	OUTPUT TAPE UNIT NUMBER VARIABLE	
LCT	NUMBER OF LINES REMAINING ON CURRENT OUTPUT PAGE	
MATL( )	MATERIAL IDENTIFICATION NUMBER FOR A NODE	

LIST OF FORTRAN VARIABLES
APPEARING IN COMMON STATEMENTS

VARIABLE NAME	DESCRIPTION	UNITS
NMM	ALWAYS EQUAL TO 1 PLUS THE ORIGINAL NUMBER OF NODES OF ABLATING MATERIAL	
NMM2	EQUAL TO NMM IF THERE ARE NO DECOMPOSING BACK-UPS, OTHERWISE EQUAL TO ONE GREATER THAN THE ORIGINAL NUMBER OF NODES IN THE MAIN ABLATING MATERIAL AND THE DECOMPOSING BACK-UPS	
NBPF	INPUT FLAG INTEGER CALLING FOR READING OF TBPF (, .) VALUES FROM SURFACE THERMOCHEMISTRY TABLES	
NBUFT(J)	INDEX IDENTIFYING THE NUMBER OF THE F-FUNCTION TABLE (NUMBERED IN ORDER INPUT) ASSIGNED TO J TH CHARRING BACK-UP	
NCON	INPUT FLAG INTEGER CALLING FOR OUTPUT OF NODAL THERMAL CONDUCTIVITY IN PLACE OF NODAL ENTHALPY IN STANDARD OUTPUT BLOCK	
NDBU	NUMBER OF DECOMPOSING BACK-UP MATERIALS	
NFI(I)	NUMBER OF THE FIRST NODE IN THE I TH DECOMPOSING BACK-UP MATERIAL	
NFIS	INPUT FLAG INTEGER CALLING FOR USE OF FISSURE MODEL IN BLOWING REDUCTION OF CONVECTIVE TRANSFER COEFFICIENTS	
NHI(I,J)	MARKS TOP ENTRY IN ABLATION PART OF A CHAR RATE TABLE FOR I TH GAS RATE AND J TH PRESSURE	
NI	NUMBER OF ISOTHERM POINTS CALLED FOR	
NL	NUMBER OF LAST NODE OF ABLATING MATERIAL	
NLA(I)	NUMBER OF THE LAST NODE IN THE I TH DECOMPOSING BACKUP MATERIAL.	
NLO(I,J)	MARKS BOTTOM ENTRY IN ABLATION PART OF A CHAR RATE TABLE FOR I TH GAS RATE AND J TH PRESSURE	
NMG	TOTAL NUMBER OF GAS RATE ENTRIES IN EACH PRESSURE GROUP OF SURFACE EQUILIBRIUM DATA	
NN	FLAG CALLING FOR PUNCH OUTPUT OF THERMOCOUPLE AND ISOTHERM DATA	
NO	NUMBER OF THERMOCOUPLE TEMPFRATURES CALLED FOR	

LIST OF FORTRAN VARIABLES
APPEARING IN COMMON STATEMENTS

VARIABLE NAME	DESCRIPTION	UNITS
NOI	NO + NI	
NPG	CURRENT PAGE NUMBER FOR OUTPUT LISTING, USED IN COMMUNICATION WITH SUBROUTINE LCOUNT	
NPR	NUMBER OF PRESSURES IN SURFACE THERMOCHEMISTRY DATA DECK	
NR	FLAG VARIABLE CALLING FOR BURNING RATE OR RADIUS RATIO CORRECTION TO INPUT CONVECTIVE TRANSFER COEFFICIENTS	
NUMN	ALWAYS EQUAL TO THE ORIGINAL TOTAL NUMBER OF NODES	
OMG	1. - GAMA	FT3-REIN-FORCEMENT/FT3 MATERIAL
OMGA(I)	1. - GA(I)	FT3-REIN-FORCEMENT/FT3 MATERIAL
P(I)	RHOV(I)/(RHOV(I)-RHOC(I)), ANALOGOUS TO PETE	
PET	DENSITY FACTOR, (CHAR DENSITY * PETE)	LB/FT3
PETE	DENSITY TERM, VIRGIN DENSITY/ (VIRGIN DENSITY - CHAR DENSITY)	
PP(I)	RHOC(I)*P(I), ANALOGOUS TO PET	LB/FT3
PSI(I,J)	DECOMPOSITION REACTION ORDER FOR THE J TH COMPONENT OF THE I TH DECOMPOSING BACK-UP MATERIAL (ANALOGOUS TO PSIA, PSIB, PSIC)	
PSIA	DECOMPOSITION REACTION ORDER FOR A COMPONENT	
PSIB	DECOMPOSITION REACTION ORDER FOR B COMPONENT	
PSIC	DECOMPOSITION REACTION ORDER FOR C COMPONENT	
PYCRI	PYROLYSIS INTERFACE CRITERION; PYROLYSIS LINE DEPTH IS DEPTH OF LINE OF DENSITY RHO(2)+PYCRI*(RHO(1)-RHO(2))	
RA( )	CURRENT LOCATION OF NODE, MEASURED FROM ORIGINAL LOCATION OF HEATED SURFACE	IN

LIST OF FORTRAN VARIABLES APPEARING IN COMMON STATEMENTS

VARIABLE NAME	DESCRIPTION	UNITS
RAV( )	SAVED ORIGINAL VALUES OF NODAL LOCATIONS RA( )	IN
RC( )	CONTACT RESISTANCE BETWEEN INDICATED NODE AND AND NEXT NODE DOWN	(FT2-SEC-DEG F)/BTU
RECORD( )	ALPHAMERIC TITLING INFORMATION	
RFT	NOT CURRENTLY USED	
RHO( )	DENSITY OF VIRGIN PLASTIC (1), PURE CHAR (2), OR BACK-UP MATERIALS (3-10)	LB/FT3
RHOC(I)	CHAR DENSITY OF I TH DECOMPOSING BACK-UP MATERIAL (ANALOGOUS TO RHO(2))	LB/FT3
RHOO(I,J), J= 1,2	ORIGINAL DENSITY OF J TH COMPONENT OF I TH DECOMPOSING BACK-UP PER UNIT VOLUME OF RESIN (ANALOGOUS TO RHOOA, RHOOB)	LB/FT3
RHOO(I,3)	ORIGINAL DENSITY OF THIRD COMPONENT OF I TH DECOMPOSING BACK-UP FOR UNIT VOLUME OF REINFORCEMENT (ANALOGOUS TO RHOOC)	LB/FT3
RHOOA	ORIGINAL DENSITY OF COMPONENT A PER UNIT VOLUME OF RESIN	LB/FT3
RHOOB	ORIGINAL DENSITY OF COMPONENT B PER UNIT VOLUME OF RESIN	LB/FT3
RHOOC	ORIGINAL DENSITY OF COMPONENT C PER UNIT VOLUME OF REINFORCEMENT	LB/FT3
RHOR(I,J), J = 1,2	RESIDUAL DENSITY OF J TH COMPONENT OF I TH DECOMPOSING BACK-UP PER UNIT VOLUME OF RESIN (ANALOGOUS TO RHORA, RHORB)	LB/FT3
RHOR(I,3)	RESIDUAL DENSITY OF THIRD COMPONENT OF I TH DECOMPOSING BACK-UP PER UNIT VOLUME OF REINFORCEMENT (ANALOGOUS TO RHORC)	LB/FT3
RHORA	RESIDUAL DENSITY OF COMPONENT A PER UNIT VOLUME OF RESIN	LB/FT3
RHORB	RESIDUAL DENSITY OF COMPONENT B PER UNIT VOLUME OF RESIN	LB/FT3
RHORC	RESIDUAL DENSITY OF COMPONENT C PER UNIT VOLUME OF REINFORCEMENT	LB/FT3

LIST OF FORTRAN VARIABLES
APPEARING IN COMMON STATEMENTS

VARIABLE NAME	DESCRIPTION	UNITS
RHOV(I)	VIRGIN DENSITY OF I TH DECOMPOSING BACK-UP MATERIAL (ANALOGOUS TO RHO(I))	LB/FT3
ROA( )	CURRENT DENSITY OF COMPONENT A PER UNIT VOLUME OF RESIN, AT A NODELET	LB/FT3
ROB( )	CURRENT DENSITY OF COMPONENT B PER UNIT VOLUME OF RESIN, AT A NODELET	LB/FT3
ROC( )	CURRENT DENSITY OF COMPONENT C PER UNIT VOLUME OF REINFORCEMENT	LB/FT3
ROCOM(I,J), J = 1,2	DENSITY OF THE J TH COMPONENT IN THE I TH NODE (BACK-UPS ONLY) PER UNIT VOLUME OF RESIN (ANALOGOUS TO ROA(I), ROB(I))	LB/FT3
ROCOM(I,3)	DENSITY OF THE THIRD COMPONENT IN THE I TH NODE (BACK-UPS ONLY) PER UNIT VOLUME OF RESIN (ANALOGOUS TO ROC(I))	LB/FT3
RSV	ORIGINAL SURFACE RADIUS (NEGATIVE IF EXTERNAL)	IN
SU( )	THERMOCOUPLE DEPTHS AND/OR ISOTHERM TEMPERATURES	IN OR DEG R
SWELL	PROPORTIONALITY FACTOR IN CHAR SWELL CORRECTION OF HEAT TRANSFER COEFFICIENT	
TA( )	NODAL TEMPERATURE	DEG R
TBPF(I,J,K)	TABULAR VALUE OF B PRIME FAIL (THAT IS, MDOT FAIL/RHOE-UE-CM) IN SURFACE THERMOCHEMISTRY TABLE FOR I TH ENTRY, J TH PYROLYSIS GAS RATE, AND K TH PRESSURE	
TBRP(I)	I TH ENTRY IN TIME TABLE VALUES OF BLOWING REDUCTION PARAMETER LAMDA	
TCBU(I,J)	TABULAR VALUE OF SPECIFIC HEAT FOR I TH TEMPERATURE ENTRY AND J TH MATERIAL INDEX NUMBER FOR DECOMPOSING BACK-UPS (ANALOGOUS TO THZ(I,J))	BTU/LB DEG R
TCHEM (I,J,K)	QUANTITY (CH/CM * CHEM PROD - HW) FOR I TH CHAR RATE, J TH GAS RATE, AND K TH PRESSURE	BTU/LB
TCH( )	TABULAR VALUE OF HEAT TRANSFER COEFFICIENT RHOE-UE-CM IN FUNCTIONS-OF-TIME TABLES	LB/FT2-SEC
TCP(I,J)	TABULAR VALUE OF SPECIFIC HEAT FOR I TH TEMPERATURE ENTRY AND J TH MATERIAL	BTU/LB-DEG R

LIST OF FORTRAN VARIABLES APPEARING IN COMMON STATEMENTS

VARIABLE NAME	DESCRIPTION	UNITS
TCPSEN(I,J)	SLOPE OF THSEN VERSUS TW AT I TH TEMPERATURE AND J TH PRESSURE IN EDGE TABLE	BTU/LB-DEG R
TENT(I,J)	TABULAR VALUE OF SPECIFIC HEAT FOR I TH TEMPERATURE ENTRY AND J TH MATERIAL INDEX NUMBER FOR DECOMPOSING BACK-UPS (ANALOGOUS TO THZ(I,J))	BTU/LB
TEP(I,J)	TABULAR VALUE OF EMISSIVITY OF I TH TEMPERATURE ENTRY AND J TH MATERIAL	
THE( )	TABULAR VALUE OF BOUNDARY RECOVERY ENTHALPY IN FUNCTION-OF-TIME TABLES (EQUALS SURFACE TEMPERATURE IN OPTION 2 AND VIEW FACTOR IN OPTION 3)	BTU/LB OR DEG R OR ---
THFIN	TIME AT END OF PROBLEM	SEC
THG( )	TABULAR VALUE OF PYROLYSIS GAS ENTHALPY AS A FUNCTION OF TEMPERATURE	BTU/LB
THSEN(I,J)	VALUE OF HEW AT I TH TEMPERATURE AND J TH PRESSURE IN EDGE TABLES	BTU/LB
THZ(I,J)	TABULAR VALUE OF SENSIBLE ENTHALPY OF I TH TEMPERATURE ENTRY AND J TH MATERIAL	BTU/LB
THZRO	INITIAL PROBLEM TIME	SEC
TKBU(I,J)	TABULAR VALUE OF THERMAL CONDUCTIVITY FOR I TH TEMPERATURE ENTRY AND J TH MATERIAL INDEX NUMBER FOR DECOMPOSING BACK-UPS (ANALOGOUS TO TKP(I,J))	BTU/FT-SEC-DEG F
TKP(I,J)	TABULAR VALUE OF THERMAL CONDUCTIVITY FOR I TH TEMPERATURE ENTRY AND J TH TEMPERATURE	BTU/FT-SEC-DEG F
TLMC(I,J,K)	TABULAR VALUE OF LN(MDOTC/RHOE-UE-CM) IN SURFACE THERMOCHEMISTRY TABLE FOR I TH CHAR RATE, J TH PYROLYSIS GAS RATE, AND K TH PRESSURE	
TMG(I,J)	TABULAR VALUES OF GAS RATES APPEARING IN SURFACE THERMOCHEMISTRY TABLES, I GIVES GAS RATE ENTRY, J GIVES PRESSURE INDEX	
TMWT	NOT CURRENTLY USED	
TPI( )	TABULAR VALUE OF LN OF PRESSURE IN FUNCTIONS-OF-TIME TABLE	
TPR( )	TABULAR VALUE OF LN OF PRESSURE IN SURFACE THERMOCHEMISTRY TABLES	

LIST OF FORTRAN VARIABLES APPEARING IN COMMON STATEMENTS

VARIABLE NAME	DESCRIPTION	UNITS
TPR2	TIME OF TRANSITION FROM INITIAL TO SECOND OUTPUT TIME INTERVAL	SEC
TPR3	TIME OF TRANSITION FROM SECOND TO THIRD OUTPUT TIME INTERVAL	SEC
TQR( )	TABULAR VALUE OF RADIANT HEAT FLUX IN FUNCTIONS--OF-TIME TABLE, FOR OPTIONS 1 AND 3 (OPTION 2, SURFACE RECESSION RATE)	BTU/FT2-SEC OR MILS/SEC
TRAC(I,J)	LIMIT TEMPERATURE BELOW WHICH COMPONENT J OF DECOMPOSING BACK-UP I IS NOT ALLOWED TO DECOMPOSE (EFFICIENCY MEASURE) (ANALOGOUS TO TRACA,TRACB, TRACC)	DEG R
TRACA	LIMIT TEMPERATURE BELOW WHICH COMPONENT A IS NOT ALLOWED TO DECOMPOSE (EFFICIENCY MEASURE)	DEG R
TRACB	LIMIT TEMPERATURE BELOW WHICH COMPONENT B IS NOT ALLOWED TO DECOMPOSE (EFFICIENCY MEASURE)	DEG R
TRACC	LIMIT TEMPERATURE BELOW WHICH COMPONENT C IS NOT ALLOWED TO DECOMPOSE (EFFICIENCY MEASURE)	DEG R
TRACM	MINIMUM OF TRACA, TRACB, TRACC	
TREF(I)	REFERENCE TEMPERATURE FOR HEATS OF FORMATION ANALOGOUS TO TZ) FOR I TH DECOMPOSING BACK-UP MATERIAL.	DEG R
TRES	RESERVOIR TEMPERATURE TO WHICH BACK WALL IS EXPOSED	DEG R
TTH( )	TABULAR VALUE OF TIME (INDEPENDENT VARIABLE) IN FUNCTIONS-OF-TIME TABLE	
TTS(I,J,K)	TABULAR VALUE OF TEMPERATURE IN SURFACE THERMO-CHEMISTRY TABLES FOR I TH TEMPERATURE, J TH PYROLYSIS GAS RATE, AND K TH PRESSURE	DEG R
TTSEN(I,J)	TABULAR VALUE OF TEMPERATURE (INDEPENDENT VARI-ABLE) IN EDGE TABLES FOR I TH TEMPERATURE ENTRY IN J TH PRESSURE GROUP	DEG R
TT1( )	TABULAR VALUE OF TEMPERATURE (INDEPENDENT VARIABLE) IN PYROLYSIS GAS ENTHALPY TABLE	DEG R
TT2(I,J)	TABULAR VALUE OF TEMPERATURE (INDEPENDENT VARIABLE) IN MATERIAL PROPERTIES TABLES FOR I TH TEMPERATURE ENTRY IN TABLE FOR J TH MATERIAL	DEG R

LIST OF FORTRAN VARIABLES
APPEARING IN COMMON STATEMENTS

VARIABLE NAME	DESCRIPTION	UNITS
TT5(I,J)	TABULAR VALUE OF TEMPERATURE (INDEPENDENT VARIABLE) IN MATERIAL PROPERTIES TABLES FOR I TH TEMPERATURE ENTRY IN TABLE FOR J TH INDEX NUMBER FOR DECOMPOSING BACK-UPS (ANALOGOUS TO TT2)	DEG R
TX(I,J)	TABULAR VALUE OF PLASTIC MASS FRACTION X, INDEPENDENT VARIABLE IN TABLES OF F1(I,J), F2(I,J)	LB VIRGIN/ LB MATERIAL
VFZ	INPUT OPTION 1 VIEW FACTOR	
VR	TABULAR INTERPOLATION RATIO RETURNED BY LOOK SUBROUTINE	
WT	NUMBER OF THE F-FUNCTION TABLE (NUMBERED IN ORDER INPUT) ASSIGNED TO THE MAIN CHARRING MATERIAL	
X( )	MASS FRACTION OF VIRGIN PLASTIC PER UNIT MASS OF MATERIAL	

LIST OF FORTRAN VARIABLES
APPEARING IN SUBROUTINE CBM

VARIABLE NAME	DESCRIPTION	UNITS.
A(I)	COEFFICIENT ON NEW TEMPERATURE OF NODE I-1 IN EQUATION OF NODE I IN IMPLICIT MATRIX	BTU/FT3 - DEG F
ASU	CURRENT CROSS SECTION AREA OF SURFACE NODE	FT2
B(I)	COEFFICIENT ON NEW TEMPERATURE OF NODE I IN EQUATION OF NODE I IN IMPLICIT MATRIX	BTU/FT3 - DEG F
BF	AN UNCORRECTED B PRIME, EQUAL TO (MDOTG + MDOTC)/ RHOE-UE-CM, ALSO SEE NEXT ENTRY	
BF	REPLACES BBB(I,J) FOR CONVENIENCE, ALSO SEE ABOVE ENTRY	SEC-1
BPRM	BPRIME = (MDOTG + MDOTC)/RHOE-UE-CM	
BPRMG	BPRIMEG = MDOTG/RHOE-UE-CM	
BR	CH/CHO	
C(I)	COEFFICIENT ON NEW TEMPERATURE OF NODE I+1 IN IN EQUATION OF NODE I IN IMPLICIT MATRIX	BTU/FT3 - DEG F
CH	HEAT TRANSFER COEFFICIENT - RHOE-UE-CH	LB/FT2-SEC
CHZ	HEAT TRANSFER COEFFICIENT NOT CORRECTED FOR BLOWING	LB/FT2-SEC
CMD	CHAR RATE, MDOTC	LB/FT2-SEC
CMDL	LN (MDOTC/RHOE-UE-CM)	
CMFL	VALUE OF THAT PART OF EROSION RATE DUE TO FAILING	LB/FT2 SEC
CMMA	MINIMUM (FROM VARIOUS TABLES) VALUE OF AVERAGES OF NEXT TWO SUCCESSIVE TABULAR VALUES OF TLMC (, ,) ABOVE CURRENT CMDL. USED TO LIMIT CORRECTION SIZE ON CMDL	
CMMI	MAXIMUM VALUE (FROM VARIOUS TABLES) OF AVERAGES OF NEXT TWO SUCCESSIVE TABULAR VALUES OF TLMC (, ,) BELOW CMDL, USED TO LIMIT CORRECTION SIZE ON CMDL	
CNC( )	VALUE OF CHAR THERMAL CONDUCTIVITY AT A NODE	BTU/FT-SEC DEG F

LIST OF FORTRAN VARIABLES
APPEARING IN SUBROUTINE CBM

VARIABLE NAME	DESCRIPTION	UNITS
CNO(I)	THERMAL CONDUCTIVITY OF NODE I GENERATED FOR OUTPUT PURPOSES IF NCON DIFFERS FROM ZERO	BTU/FT SEC DEG R
CMT	TOTAL AMOUNT OF CHAR ABLATED AWAY, PER UNIT AREA OF ORIGINAL SURFACE	LB/FT2
CN( )	VALUE OF THERMAL CONDUCTIVITY AT A NODE	BTU/FT-SEC-DEG F
COLD	SAVED PREVIOUS VALUE OF CHAR INTERFACE DEPTH	IN
CP( )	SPECIFIC HEAT AT A NODE	BTU/LB-DEG F
CPC(I)	SAVED VALUE OF CHAR SPECIFIC HEAT FOR NODE I	BTU/LB CHAR-DEG R
CPE( )	CHAR OR PYROLYSIS INTERFACE DEPTH	IN
CPGAS	SPECIFIC HEAT OF PYROLYSIS GAS	BTU/LB-DEG F
CPNL	SPECIFIC HEAT AT LAST NODE OF ABLATING MATERIAL	BTU/LB-DEG F
CPV( )	SPECIFIC HEAT OF VIRGIN PLASTIC COMPONENT AT A NODE	BTU/LB-DEG F
CPT	SPECIFIC HEAT OF TOP NODELET IN CURRENT NODE	BTU/LB-DEG F
CZ	RELATIVE THICKNESS PARAMETER USED IN DROPPING LAST NODE	
D(I)	RIGHT HAND TERM IN IMPLICIT MATRIX EQUATION FOR NODE I	BTU/FT3
DCDT	ABSOLUTE VELOCITY OF CHAR INTERFACE	IN/SEC
DECOM	CURRENT ACCUMULATED (NODE BY NODE) AMOUNT OF ENERGY ABSORPTION IN DECOMPOSITION	BTU/FT2-SEC
DECOMT	TIME INTEGRATED VALUE OF DECOM, ADJUSTED TO UNIT AREA OF ORIGINAL SURFACE	BTU/FT2
DEDT	CURRENT ACCUMULATED (NODE BY NODE) RATE OF ENERGY ABSORPTION IN SOLIDS, (BACK-UPS EXCLUDED)	BTU/FT2-SEC
DEDTT	TIME INTEGRATED VALUE OF DEDT, ADJUSTED TO UNIT AREA OF ORIGINAL SURFACE	BTU/FT2
DELCR	MINIMUM OF DEL(1)/FJFH AND DELM/FJFS	FT

LIST OF FORTRAN VARIABLES APPEARING IN SUBROUTINE CBM

VARIABLE NAME	DESCRIPTION	UNITS
DELR	THICKNESS RATIO USED IN DROPPING LAST NODE	
DENOLD	SAVED VALUE OF DENSITY OF PREVIOUS NODELET USED IN INTERPOLATING CHAR AND PYROLYSIS INTERFACES	LB/FT3
DEP(I,J)	J TH DEPTH OF THE I TH ISOTHERM IN THE BACKUP MATERIAL	IN
DERR	(1) IN ABLATING SECTION OF SURFACE ENERGY BALANCE	BTU/FT2-SEC
DERR	RATE OF CHANGE OF ERR WITH LN B PRIME CHAR (IN ABLATING SECTION OF SURFACE ENERGY BALANCE CALCULATIONS) OR WITH SURFACE TEMPERATURE (IN NON-ABLATING SECTION)	BTU/FT2-SEC OR BTU/FT2-SEC-DEG F
DIDT	RATE OF SURFACE RECESSION	IN/SEC
DMDG( )	ACCUMULATED AMOUNT OF PYROLYSIS GAS GENERATION IN A NODE PER UNIT AREA AND TIMES NUMBER OF NODELETS PER NODE, FINALLY ADJUSTED TO AMOUNT OF PYROLYSIS GAS GENERATION IN A NODE	LB/SEC-FT2 SURFACE
DMIV	DERIVATIVE OF EMISSIVITY WITH RESPECT TO TEMPERATURE	DEG F-1
DNCP( )	CHAR AND PYROLYSIS LINES CRITERIAL DENSITIES, SEE CHCRI AND PYCRI	LB/FT3
DNS	CURRENT NODELET DENSITY	LB/FT3
DPDT	ABSOLUTE VELOCITY OF PYROLYSIS INTERFACE	IN/SEC
DRL	DENSITY-THICKNESS PRODUCT FOR NODE ABOVE NODE TO BE DROPPED	LB/FT2
DRLC	DENSITY-THICKNESS-SPECIFIC HEAT PRODUCT FOR NODE ABOVE NODE TO BE DROPPED.	BTU/FT2-DEG F
DRLCP	DENSITY-THICKNESS-SPECIFIC HEAT PRODUCT FOR NODE TO BE DROPPED	BTU/FT2 - DEG F
DRLP	DENSITY-THICKNESS PRODUCT FOR NODE TO BE DROPPED	LB/FT2
DROAC	RATE OF CHANGE OF DENSITY OF COMPONENT A AT CONSTANT X DUE TO CONVECTION	LB/FT3 - RESIN-SEC
DRCAT	RATE OF CHANGE OF DENSITY OF COMPONENT A AT CONSTANT Y	LB/FT3 - RESIN-SEC

LIST OF FORTRAN VARIABLES
APPEARING IN SUBROUTINE CBM

VARIABLE NAME	DESCRIPTION	UNITS
DROBC	RATE OF CHANGE OF DENSITY OF COMPONENT B AT CONSTANT X DUE TO CONVECTION	LB/FT3 - RESIN-SEC
DROBT	RATE OF CHANGE OF DENSITY OF COMPONENT B AT CONSTANT Y	LB/FT3 - RESIN-SEC
DROCC	RATE OF CHANGE OF DENSITY OF COMPONENT C AT CONSTANT X DUE TO CONVECTION	LB/FT3 REINFORCE-MENT-SEC
DROCT	RATE OF CHANGE OF DENSITY OF COMPONENT C AT CONSTANT Y	LB/FT3 REINFORCE-MENT-SEC
DRODTD	TOTAL RATE OF CHANGE OF DENSITY AT CONSTANT Y FOR CURRENT NODE, -DMDG(I)/(RR(I)*DEL(I))	LB/FT3-SEC
DROT(J)	LOCAL RATE OF CHANGE IN DENSITY OF COMPONENT J, WHERE J IS THE COMPONENT INDEX (J=1,2,3) IN THE DECOMPOSING BACK-UPS (ANALOGOUS TO DROAT, DROBT, DROCT)	LB/FT3-SEC
DS	SURFACE RECESSION DURING TIME STEP	FT
DSDT	SURFACE RECESSION RATE	FT/SEC
DSDTB	NEW VALUE OF SURFACE RECESSION RATE	FT/SEC
DSI	SURFACE RECESSION DURING TIME STEP	IN
DSS	PARAMETER FJF/DEL(I)*DS/RR(I)	
DTA	TEMPERATURE INCREMENT PER HALF NODELET FOR LINEAR INTERPOLATION IN SPACE	DEG F
DTH	TIME INCREMENT	SEC
DTHC	INPUT MAXIMUM ALLOWABLE TIME STEP	SEC
DTHS	SAVED PREVIOUS VALUE OF DTH	SEC
DTS	CHANGE IN SURFACE TEMPERATURE DURING PREVIOUS COMPUTATION	DEG F
DVB	CONDUCTIVITY PARAMETER	BTU/SEC-DEG F-FT2-SURFACE
DVBS	SAVED VALUE OF DVB FOR DUMP	BTU/SEC DEG F FT2-SURFACE

LIST OF FORTRAN VARIABLES
APPEARING IN SUBROUTINE CBM

VARIABLE NAME	DESCRIPTION	UNITS
DZ	VALUE USED IN DROPPING LAST NODE	
D1( )	DUMMY VARIABLE NAME USED IN LOOK CALLS FOR DERIVATIVES OF DEPENDENT VARIABLES	VARIOUS
D2( )	DUMMY VARIABLE NAME USED IN LOOK CALLS FOR DERIVATIVES OF DEPENDENT VARIABLES	VARIOUS
D3( )	DUMMY VARIABLE NAME USED IN LOOK CALLS FOR DERIVATIVES OF DEPENDENT VARIABLES	VARIOUS
E	REPLACES EE(I,J) FOR CONVENIENCE	DEG R
EGO	ENERGY LEAVING SURFACE WITH PYROLYSIS GASES, GS*HGAS AT SURFACE TEMPERATURE	BTU/FT2-SEC
EITER( )	VALUE OF ERROR TERM IN SURFACE ENERGY BALANCE, SAVED FOR POSSIBLE DUMP FOR ALL ITERATIONS	BTU/FT2-SEC
EMIV	ABLATING SURFACE EMISSIVITY	
EMO( )	GENERAL VARIABLE NAME FOR CURVE SLOPE	VARIOUS
ERFX	COMBINATION OF TERMS IN SURFACE ENERGY BALANCE EQUATIONS WHICH DO NOT CHANGE DURING ITERATIONS	BTU/FT2-SEC
ERR	ERROR (DEPARTURE FROM ZERO) IN SURFACE ENERGY BALANCE	BTU/FT2-SEC
ERRC	CORRECTION APPLIED TO LN(MDOTC/RHOE-UE-CM) OR TO SURFACE ENERGY BALANCE OPERATION	--- OR DEG R
ERRS	SAVED VALUE OF ERROR, ERR	BTU/FT2-SEC
EZ	FACTOR USED IN DROPPING LAST NODE	
F	REPLACES FF(I,J) FOR CONVENIENCE	(LB/FT3)**(1.-PSI(I,J))
FA	DEFINED AS (1.-PSIA)*BA*(RHOOA**(1.-PSIA))	(LB/FT3)**(1.-PSIA)/SEC
FACT1	FACTOR DTM/(DEL(I)*RN(I))	SEC/FT
FACT2	FACTOR GSM/DEL(I)*RN(I)	LB/FT3-SEC
FB	DEFINED AS (1.-PSIB)*BB*(RHOOB**(1.-PSIB))	(LB/FT3)**(1.-PSIB)/SEC

LIST OF FORTRAN VARIABLES
APPEARING IN SUBROUTINE CBM

VARIABLE NAME	DESCRIPTION	UNITS
FC	DEFINED AS (1.-PSIC)*BC*(RHOOC**(1.-PSIC))	(LB/FT3)** (1.-PSIC)/SEC
FJF	NUMBER OF NODELETS IN CURRENT NODE	
FK	FACTOR USED IN COMPUTING CONVECTIVE CONTRIBUTIONS TO DENSITY CHANGES IN NODELETS OF LAST NODE OF ABLATING MATERIAL	
FX	VALUE USED IN DROPPING LAST NODE	
FZ	VALUE USED IN DROPPING LAST NODE	
GAM	REPLACES GA(I) FOR CONVENIENCE	FT3 RESIN
GS	TOTAL PYROLYSIS GAS FLOW OUT THE ABLATING SURFACE	LB/FT2 SEC
GSEGR	ENERGY TERM, SUM OF HGAS*DNDG( ) OVER NODES	BTU/SEC-FT2 SURFACE
GSM	ACCUMULATED PYROLYSIS GAS FLOW RATE ENTERING A NODE, ON A UNIT-AREA-OF-SURFACE BASIS	LB/SEC-FT2 SURFACE
GSMS	PYROLYSIS GAS FLOW OUT THE ABLATING SURFACE	LB/SEC-FT2 SURFACE
GSMT	TOTAL (TIME INTEGRATED) PYROLYSIS GAS FLOW OUT THE ABLATING SURFACE ADJUSTED TO UNIT AREA OF ORIGINAL SURFACE	LB/FT2
GSM2	ACCUMULATED PYROLYSIS GAS FLOW RATE ENTERING A NODE, ON A UNIT-AREA-OF-SURFACE BASIS, WHICH DERIVES FROM CHARRING BACK-UPS	LB/SEC-FT2 SURFACE
GSM2S	FLOW RATE OF PYROLYSIS GAS ORIGINATING IN DECOMPOSING BACK-UPS OUT THE ABLATING SURFACE	LB/SEC-FT2 SURFACE
GSM2T	TOTAL (TIME INTEGRATED) FLOW OF PYROLYSIS GAS ORIGINATING IN DECOMPOSING BACK-UPS ADJUSTED TO UNIT AREA OF ORIGINAL SURFACE	LB/FT2
GZ	FACTOR USED IN DROPPING LAST NODE	
HAPHB	COMBINED ENTHALPY PER UNIT SURFACE AREA OF NODE TO BE DROPPED AND ADJACENT NODE	BTU/FT2
HMAR	TEMPERATURE DEPENDENT REACTION ENTHALPY DEFINED AS (VIRGIN DENSITY * VIRGIN ENTHALPY - CHAR DENSITY * CHAR ENTHALPY)/(VIRGIN DENSITY- CHAR DENSITY)	BTU/LB

LIST OF FORTRAN VARIABLES APPEARING IN SUBROUTINE CBM

VARIABLE NAME	DESCRIPTION	UNITS
HBARS	SAVED VALUE OF HBAR FOR DUMP	BTU/LB
HC( )	ENTHALPY OF CHAR AT A NODE	BTU/LB
HE	TOTAL ENTHALPY OF EDGE GASES FOR OPTION 1 (EQUALS SURFACE TEMPERATURE FOR OPTION 2 OR VIEW FACTOR FOR OPTION 3)	BTU/LB, DEG R, OR --
HGAS	ENTHALPY OF PYROLYSIS GAS	BTU/LB
HP( )	ENTHALPY OF PLASTIC AT A NODE	BTU/LB
HRES	TOTAL HEAT TRANSFER COEFFICIENT AT BACK WALL (INCLUDING RADIATION)	BTU/FT2-SEC-DEG F
HW	ENTHALPY OF EDGE GASES AT WALL TEMPERATURE (OPTION 1) OR ENTHALPY OF PYROLYSIS GASES AT WALL TEMPERATURE (OPTION 3)	BTU/LB
H1	ENTHALPY OF TOP NODELET IN A NODE	BTU/LB
I	COUNTING INDEX, USUALLY FOR NODES	
IAB	FLAG USED TO DETECT FIRST PASS THROUGH ABLATING SURFACE ENERGY BALANCE PACKAGE	
IE	COUNTING INDEX	
IMG	INDEX FOR GAS RATES (MDOTG/RHOE-UE-CM)	
IMIN	INTEGER ZERO	
IPR	INDEX FOR PRESSURE ENTRIES	
IRA	SOMETIMES REPLACES IR( ) FOR EFFICIENCY	
IRB	SOMETIMES REPLACES IR( ) FOR EFFICIENCY	
IRC	SOMETIMES REPLACES IR( ) FOR EFFICIENCY	
IRD	SOMETIMES REPLACES IR( ) FOR EFFICIENCY	
IS	NOT CURRENTLY USED	
ISV	SAVED MATERIAL IDENTIFICATION NUMBER FOR FIRST NODE OF BACK-UP MATERIAL	
ITER	NUMBER OF PASSES THROUGH MAIN COMPUTATION LOOP	

LIST OF FORTRAN VARIABLES
APPEARING IN SUBROUTINE CBM

VARIABLE NAME	DESCRIPTION	UNITS
ITL	LIMIT NUMBERS (ASSUMES 2 VALUES) ON ITS TO CONTROL ITERATION EVENTS IN ABLATING SURFACE ENERGY BALANCE	
ITS	COUNTER FOR NUMBER OF ITERATIONS ON SURFACE ENERGY BALANCE	
I1	REPLACES SUBSCRIPTED INDEX FOR EFFICIENCY	
I2	REPLACES SUBSCRIPTED INDEX FOR EFFICIENCY	
I3	REPLACES SUBSCRIPTED INDEX FOR EFFICIENCY	
I4	REPLACES SUBSCRIPTED INDEX FOR EFFICIENCY	
J	GENERAL INDEX, NODELET COUNTER IN A GIVEN NODE IN DECOMPOSITION BLOCK	
J1	INDICATES NUMBER OF FIRST NODELET IN A NODE, COUNTED NODE BY NODE (EQUALS JFH + 1 FOR FIRST NODE, 1 FOR OTHERS)	
K	GENERAL UTILITY INDEX	
KI	TEMPORARY INDEX IDENTIFYING AN ISOTHERM WITHIN A BACKUP MATERIAL	
KK	COUNTER ON THERMOCOUPLE AND ISOTHERM OUTPUT	
KKSW	RETURNED ARGUMENT IN CALL OF SSWTCH (N,KKN)	
KSCT	SCRATCH TAPE LOGICAL UNIT NUMBER VARIABLE	
KT	INDEX REPLACING SUBSCRIPTED MATERIAL NUMBERS MATL( ) FOR EFFICIENCY	
L	UTILITY INDEX	
LL	UTILITY INDEX, USUALLY LOWER LIMIT OF DO LOOP INDEX	
LU	UTILITY UPPER LIMIT OF DO LOOP INDEX	
M	UTILITY INDEX	
N	GENERAL UTILITY INDEX, USED FOR COUNTING TOTAL NUMBER OF NODELETS IN DECOMPOSITION BLOCK	
NISO(KI)	NUMBER OF DEPTHS AT WHICH THE KI TH ISOTHERM OCCURS AT CURRENT OUTPUT TIME	

LIST OF FORTRAN VARIABLES
APPEARING IN SUBROUTINE CBM

VARIABLE NAME	DESCRIPTION	UNITS
NDR	NUMBER OF NODES WHICH HAVE BEEN DROPPED	
NLI	NUMBER OF LINES OF NODAL DATA OUTPUT	
NLM	NL-1	
NZ	CURRENT TOTAL NUMBER OF NODELETS	
O	FILLER FOR UNNEEDED VARIABLE NAMES IN LOOK CALL	
OMGAM	REPLACES OMGA(I) FOR CONVENIENCE	FT3 REIN-FORCEMENT/ FT3
OVR	MEASURES APPROACH OF DENSITY TO RESIDUAL DENSITY	LB/FT3
PGPU	EGO - GSEGR	BTU/SEC-FT2-SURFACE
PGPUT	TIME INTEGRATED VALUE OF PGPU, ADJUSTED TO UNIT AREA OF ORIGINAL SURFACE	BTU/FT2
PHI	PARAMETER 2.*BRP*BF	
POLD	SAVED PREVIOUS VALUE OF PYROLYSIS INTERFACE DEPTH	
POW	EXPONENT IN PYROLYSIS DECOMPOSITION RATE CALCULATIONS	
PRES	CURRENT VALUE OF LOG OF PRESSURE	
QCHEM	FROM TABLE LOOK-UP, IS INITIALLY TERM (CM/CH)*(CHEM PROD) - HW), LATER ADJUSTED TO RHOE-UE-CH*(CHEM PROD) =QCHEM	BTU/LB OR BTU/FT2-SEC
QCHEMT	TIME INTEGRATED VALUE OF QCHEM ADJUSTED TO UNIT AREA OF ORIGINAL SURFACE	BTU/FT2
QCOND	QCOND, ENERGY CONDUCTED INTO CHARRING MATERIAL AT HEATED SURFACE	BTU/FT2-SEC
QCONDT	TIME INTEGRATED VALUE OF QCOND ADJUSTED TO UNIT AREA OF ORIGINAL SURFACE	BTU/FT2
QCONV	INITIALLY DUMMY NAME FOR HEW, ADJUSTED TO QCONV = RHOE-UE-CH*(HE-HW)	BTU/LB, BTU/FT2-SEC
QCONVT	TIME INTEGRATED VALUE OF QCONV ADJUSTED TO UNIT AREA OF ORIGINAL SURFACE	BTU/FT2

LIST OF FORTRAN VARIABLES
APPEARING IN SUBROUTINE CBM

VARIABLE NAME	DESCRIPTION	UNITS
QLOSS	ENERGY LOSS QLOSS AT REAR FACE OF ABLATING MATERIAL, PER UNIT AREA OF FRONT SURFACE	BTU/SEC-FT2-SURFACE
QLOSST	TIME INTEGRATED VALUE OF QLOSS ADJUSTED TO UNIT AREA OF ORIGINAL SURFACE	BTU/FT2
QQ	DUMMY NAME, INITIAL QCONV FOR INTERPOLATION	BTU/LB
QRA	RADIANT HEAT FLUX TO SURFACE QRAD IN OPTIONS 1 AND 3 (IN OPTION 2, SURFACE RECESSION RATE)	BTU/FT2-SEC OR MILS/SEC
QRP	RADIANT HEAT ABSORBED AT SURFACE, EQUAL TO EMISSIVITY * QRA	BTU/FT2-SEC
QRPT	TIME INTEGRATED VALUE OF QRP, ADJUSTED TO UNIT AREA OF ORIGINAL SURFACE	BTU/FT2
RAD	RATE OF ENERGY RADIATION AWAY FROM SURFACE, SIGMA * EMISSIVITY * VIEW FACTOR * TS**4	BTU/FT2-SEC
RADT	TIME INTEGRATED VALUE OF RAD, ADJUSTED TO UNIT AREA OF ORIGINAL SURFACE	BTU/FT2
RAT( )	CONDUCTION RESISTANCE DEL( )/(CN( )*RR( ))	(FT2 SURF-SEC-DEG F)/BTU
RD	DENSITY DIFFERENCE USED IN PYROLYSIS CALCULATIONS	LB/FT3
REX	BURNING RATE EXPONENT PARAMETER (1.8-.2*BREX)/(1.-BREX)	
RO( )	DENSITY OF A NODE (USUALLY OLD DENSITY)	LB/FT3
RON( )	DENSITY OF A NODE (USUALLY NEW DENSITY)	LB/FT3
ROOZ	DENSITY PARAMETER, EQUAL TO ZERO OR TO FJFH TIMES UNIFORM NODELET DENSITIES IN AREAS WITHOUT DECOMPOSITION REACTIONS (PURE PLASTIC OR PURE CHAR), USED TO EXPEDITE DENSITY CALCULATIONS	LB/FT3
ROT( )	DENSITY OF TOP NODELET IN A GIVEN NODE	LB/FT3
ROI	REPLACES ROT( ) FOR EFFICIENCY	LB/FT3
RR( )	OBTAINED FROM UGLE AS CROSS-SECTION AREA OF A NODE, LATER NORMALIZED ON CROSS-SECTION AREA OF SURFACE NODE	FT2 OR ---

LIST OF FORTRAN VARIABLES
APPEARING IN SUBROUTINE CBM

VARIABLE NAME	DESCRIPTION	UNITS
RSU	CURRENT SURFACE RADIUS (TOTAL RECESSION FOR PLANE GEOMETRY	IN
SA	CURRENT VALUE OF TOTAL SURFACE RECESSION	IN
SDNET	RATE OF RECESSION AFTER RATE OF CHAR SWELL IS ACCOUNTED FOR	IN/SEC
SIG	STEFAN-BOLTZMANN CONSTANT	BTU/FT2-SEC-DEG R**4
SNET	NEW SURFACE RECESSION AFTER SWELL IS ACCOUNTED FOR	IN
SUEGR	TERM HGAS*DMDG( ), SUMMED OVER ALL NODES	BTU/FT2 - SURFACE-SEC
T	TERM USED IN EVALUATING SOLID CONVECTION ENERGY	BTU/FT3
TABC	INTERPOLATED TEMPERATURE APPROXIMATING BOTTOM OF ABLATION-SECTION OF SURFACE THERMOCHEMISTRY TABLES, COMPARED TO OLD VALUE OF SURFACE TEMPERATURE TO JUDGE IF ABLATION-SECTION SHOULD BE USED	DEG R
TAS	NODELET TEMPERATURE	DEG R
TB	SUMMATION OF TN*DSDT*RR(I) OVER NODES OF ABLATING MATERIAL	BTU/SEC-FT2-SURFACE
TEMP	TEMPORARY NODAL TEMPERATURE	DEG R
TERM1	FACT1 * DVB	BTU/FT-DEC F FT2-SURFACE
TERM2	LUMPING OF TERMS USEFUL IN COMPUTING IMPLICIT TEMPERATURE COEFFICIENTS, SEE STATEMENT 14 + 6	BTU/FT2 - DEG F
TERM3	LUMPING OF TERMS USEFUL IN COMPUTING IMPLICIT TEMPERATURE COEFFICIENTS, SEE STATEMENT 25	BTU/FT3-DEG F-SEC
TM	TIME	SEC
TMDS	VALUE OF TIME AT A TIME-TABLE DOUBLE ENTRY (SHIFT OF OPTION)	SEC
TMPRT	OUTPUT TIME	SEC
TN	TERM USED IN EVALUATING SOLID CONVECTION ENERGY	BTU/FT3
TU( )	THERMOCOUPLE TEMPERATURE OR ISOTHERM DEPTH	DEG R OR IN

LIST OF FORTRAN VARIABLES
APPEARING IN SUBROUTINE CBM

VARIABLE NAME	DESCRIPTION	UNITS
TOP1	COMBINED MASS OF NODE TO BE DROPPED AND ADJACENT NODE	LB/FT2
TOP2	COMBINED THERMAL CAPACITY OF NODE TO BE DROPPED AND ADJACENT NODE	BTU/FT2 - DEG R
TOP3	COMBINED ENTHALPY OF NODE TO BE DROPPED AND ADJACENT NODE	BTU/FT2
TRACMI	MINIMUM VALUE OF A SET OF TRAC(I,J), J= 1,3	DEG R
TS	SURFACE TEMPERATURE, EQUIVALENCED TO TA(1)	DEG R
TSAVE	SAVED VALUE OF SURFACE TEMPERATURE FROM PREVIOUS TIME STEP	DEG R
TSMA	MINIMUM (FROM VARIOUS TABLES) VALUE OF AVERAGES OF NEXT TWO TABULAR VALUES OF TTS(, ,)ABOVE CURRENT TS, USED TO LIMIT CORRECTION SIZE ON TS	DEG R
TSMI	MAXIMUM (FROM VARIOUS TABLES) VALUE OF AVERAGES OF NEXT TWO TABULAR VALUES OF TTS (, ,) BELOW CURRENT TS, USED TO LIMIT CORRECTION SIZE ON TS	DEG R
TSSQ	SQUARE OF SURFACE TEMPERATURE	DEG R**2
TT	TIME INTEGRATED VALUE OF TB ADJUSTED TO UNIT AREA OF ORIGINAL SURFACE	BTU/FT2
VF	VIEW FACTOR	
VITER( )	VALUE OF LN(MDOTC/RHOE-UE-CM) OR SURFACE TEMPERATURE (FOR A NON-ABLATING CASE) SAVED FOR EACH ITERATION OF SURFACE ENERGY BALANCE, FOR POSSIBLE DUMP	--- OR DEG R
VOL	VOLUME OF NEW AMALGAMATED LAST NODE IN MAIN MATERIAL	FT3/FT2-SURFACE
VRM	REPLACES VR FOR PYROLYSIS GAS RATE INTERPOLATION	
VRP	REPLACES VR FOR PRESSURE INTERPOLATION	
XP1	REPLACES X(1) FOR EFFICIENCY	
X1	X( ) FOR TOP NODELET IN A NODE	
Y1( )	DUMMY VARIABLE NAME USED IN LOOK CALLS FOR DEPENDENT VARIABLES	VARIOUS

LIST OF FORTRAN VARIABLES
APPEARING IN SUBROUTINE CBM

VARIABLE NAME	DESCRIPTION	UNITS
Y2( )	DUMMY VARIABLE NAME USED IN LOOK CALLS FOR DEPENDENT VARIABLES	VARIOUS
Y3( )	DUMMY VARIABLE NAME USED IN LOOK CALLS FOR DEPENDENT VARIABLES	VARIOUS

LIST OF FORTRAN VARIABLES
APPEARING IN SUBROUTINE INPOUT

VARIABLE NAME	DESCRIPTION	UNITS
AE	EXPONENT ON RADIUS GIVING NODAL CROSS-SECTIONAL AREA VARIATION WITH RADIUS	
A9	ALPHAMERIC IDENTIFICATION VARIABLE FOR COMPONENT A	
B	REPLACES BLANK	
BP	B PRIME = (MDOTC+MDOTG)/RHOE-UE-CM	
BPG	BPRIMEG = MDOTG/RHOE-UE-CM	
B9	ALPHAMERIC IDENTIFICATION VARIABLE FOR COMPONENT B	
CMHS	INPUT VALUE OF CMH	
CT1	UNUSED PLACE HOLDING VARIABLE IN LOOK CALL	
CT2	UNUSED PLACE HOLDING VARIABLE IN LOOK CALL	
C9	ALPHAMERIC IDENTIFICATION VARIABLE FOR COMPONENT C	
DMS	TEST VALUE OF PYROLYSIS GAS RATE, MDOTG/RHOE-UE-CM	
DUM	UNUSED PLACE HOLDING VARIABLE IN LOOK CALL	
GAMAM	MASS FRACTION OF RESIN (COMPONENTS A AND B) IN UNDECOMPOSED PLASTIC	LB RESIN/ LB VIRGIN
HCH	ENTHALPY OF CHAR	BTU/LB
HE	TOTAL ENTHALPY OF EDGE GASES AT A GIVEN TEMPERATURE	BTU/LB
HGA	ENTHALPY OF PYROLYSIS GAS	BTU/LB
HSH	DATUM ENTHALPY AT REFERENCE TEMPERATURE TZ	BTU/LB
HZ	Z ENTHALPY TERM FOR EDGE GAS AT A GIVEN TEMPERATURE	BTU/3B
I	UTILITY INDEX	
IFN	INDEX USED IN OUTPUTTING PYROLYSIS GAS ENTHALPY TABLE	

LIST OF FORTRAN VARIABLES APPEARING IN SUBROUTINE INPOUT

VARIABLE NAME	DESCRIPTION	UNITS
IG	FLAG USED TO MARK A MAXIMUM TEMPERATURE ENTRY IN A CHAR RATE TABLE	
IN	UTILITY INDEX	
IOPT(I)	HEATING OPTION (1,2, OR 3) FOR TIME TABLE TABULAR ENTRY I	
IP	INDEX ON PRESSURE IN SURFACE THERMOCHEMISTRY TABLE INPUT	
IPN	INDEX ON PRESSURE IN SURFACE THERMOCHEMISTRY TABLE INPUT	
IS	SAVED VALUE OF II	
IT	UTILITY INDEX	
IX	FLAG ON TYPE OF ERROR STOP IN SURFACE THERMO-CHEMISTRY INPUT	
IZ( )	OUTPUT INDEX ARRAY FROM SUBROUTINE ORDERD	
J	UTILITY INDEX	
JBU	COUNTER FOR NUMBER OF CHARRING BACK-UPS ASSIGNED TO AN F-FUNCTION TABLE	
JNG	FLAG TO IDENTIFY TYPE OF SURFACE THERMOCHEMISTRY TABLE, -1 FOR EDGE TABLE, 0 FOR ZERO CHAR RATE TABLE (INDEPENDENT SURFACE TEMPERATURE), GREATER THAN 0 FOR SURFACE EQUILIBRIUM (SURFACE TEMPERATURE DEPENDENT)	
J1	INDEX LIMIT EQUAL TO NUMBER OF NODELETS IN CURRENT NODE	
K	UTILITY INDEX	
KM	ORDINAL RANK OF DECOMPOSING BACK-UP MATERIAL, COUNTING FROM BACK WALL OF MAIN ABLATING MATERIAL	
KMS	SAVED VALUE OF KM	
KKSW	RETURNED ARGUMENT IN CALL OF SSWTCH (N,KKSW)	
KMTL(I)	INPUT ARRAY OF MATERIAL SEQUENCE NUMBERS (ZERO FOR MAIN MATERIAL, 1 TO 5 FOR CHARRING BACK-UPS) ASSIGNED TO CURRENT F-FUNCTION TABLES	

LIST OF FORTRAN VARIABLES APPEARING IN SUBROUTINE INPOUT

VARIABLE NAME	DESCRIPTION	UNITS
KNST	CHECK INTEGER TO FLAG FIRST SURFACE TABLE INPUT	
KSV(J)	SAVED NON-ZERO VALUE OF KMTI(I)	
KT	INDEX REPLACING SUBSCRIPTED MATERIAL NUMBERS MATL( ) FOR EFFICIENCY	
L	UTILITY INDEX	
LL	UTILITY INDEX	
LLL	NUMBER OF LINES OF OUTPUT OF A GIVEN CHAR RATE TABLE	
LU	UTILITY UPPER LIMIT ON DO LOOPS	
N	INDEX FOR NODELETS	
NC	FLAG MARKING PYROLYSIS GAS ENTHALPY CARD PAIRS AND END OF FUNCTIONS-OF-TIME TABLES	
NDBUCH	CHECK VALUE FOR NDBU SUMMED DURING NODAL DATA INPUT	
NMC	NUMBER OF ENTRIES IN CURRENT MDOTC TABLE	
NOP	EQUAL TO NO + 1	
NOPT	ACCUMULATED NUMBER OF OPTIONS APPEARING IN A TIME-TABLE	
NSEN	NUMBER OF ENTRIES IN CURRENT EDGE TABLE	
NST	INPUT FLAG, NON-ZERO VALUE CALLING FOR RE-USE OF PREVIOUSLY INPUT SURFACE THERMOCHEMISTRY TABLES	
NTH	NUMBER OF TIME POINTS IN FUNCTIONS-OF-TIME TABLES (ACCUMULATED)	
NTI	INDEX USED TO COUNT ENTRIES IN PYROLYSIS GAS ENTHALPY TABLE	
PSV	SAVED TEST VALUE OF PRESSURE DURING INPUT OF SURFACE THERMOCHEMISTRY TABLES	ATM
RHR	TEMPORARILY REPLACES RHOC(K) OR RHOV(K) FOR CONVENIENCE	LB/FT3
RSVN	POSITIVE VALUE FOR RSV	INCHES

LIST OF FORTRAN VARIABLES
APPEARING IN SUBROUTINE INPOUT

VARIABLE NAME	DESCRIPTION	UNITS
TCZSEN(I,J)	DERIVATIVE OF FROZEN EDGE GAS Z-ENTHALPY WITH RESPECT TO TEMPERATURE AT I TH EDGE TABLE POINT IN TABLE FOR J TH PRESSURE	BTU/ LB-DEG R
TSEN(I)	READ IN AS ENTHALPY IN FROZEN EDGE TABLES AND WALL ENTHALPY IN SURFACE THERMOCHEMISTRY TABLES BUT LATER CONVERTED TO FROZEN EDGE ENTHALPY	BTU/LB
TSURF(I)	NAME OF SURFACE SPECIES FOR I TH TABLE ENTRY	
TZ	REFERENCE TEMPERATURE FOR HEAT OF FORMATION	DEG R
TZSEN(I,J)	Z-ENTHALPY TERM AT I TH ENTRY IN FROZEN EDGE TABLE FOR J TH PRESSURE	BTU/LB DEG R
VKH	FLOATING KH	
WLQ	UNEQUAL DIFFUSION EXPONENT	
WLS	SAVED TEST VALUE OF WLQ	

LIST OF FORTRAN VARIABLES APPEARING IN SUBROUTINE THERM

VARIABLE NAME	DESCRIPTION	UNITS
CN(I)	VALUE OF THERMAL CONDUCTIVITY OF THE I TH NODE	BTU/FT SEC DEG F
DEP(I,J)	J TH DEPTH OF THE I TH ISOTHERM IN THE BACKUP MATERIAL	IN
DIS	DISTANCE BETWEEN A THERMOCOUPLE LOCATION AND AN ADJACENT NODAL LOCATION FOR INTERPOLATION PURPOSES	FT
DIS2	INTERPOLATION QUANTITY WHICH ACCOUNTS FOR CONTACT RESISTANCE IN THE EVALUATION OF THE TEMPERATURE OF A THERMOCOUPLE AT AN INTERFACE	FT
I	LOOP INDEX	
IMNS	INTEGER USED IN SEARCHING FOR ISOTHERM LOCATION	
IPLS	INTEGER USED IN SEARCHING FOR ISOTHERM LOCATION	
ISO	NUMBER OF BACKUP NODE OR NUMBER OF BACKUP NODES + 1	
ISOT	CURRENT INDEX IDENTIFYING THE ISOTHERM TEMPERATURE	
J,K,L,M	TEMPORARY NODE IDENTIFIER OR LOOP INDEX	
N	NUMBER OF DEPTHS OF CURRENT ISOTHERM	
NISO(KI)	NUMBER OF DEPTHS OF THE KI TH ISOTHERM	
QI	HEAT FLUX BETWEEN ADJACENT NODES OF DISSIMILAR MATERIALS. USED FOR INTERPOLATION IN ISOTHERM LOCATING LOGIC	BTU/FT2-SEC
RAISO(I)	DEPTH OF THE I TH NODE BELOW THE CURRENT SURFACE, I=1 IS THE LAST NODE OF MAIN MATERIAL	IN
RAT(I)	CONDUCTION RESISTANCE BETWEEN THE I TH NODE AND I+1 NODE	FT2-SEC-DEG-F/BTU
RR(I)	RELATIVE AREA OF THE I TH NODE (AS DEFINED IN CBN)	
T	TEMPERATURE OF CURRENT ISOTHERM	DEG R
TI	TEMPERATURE OF NODE ABOVE OR BELOW CURRENT ISOTHERM	DEG R

LIST OF FORTRAN VARIABLES APPEARING IN SUBROUTINE THERM

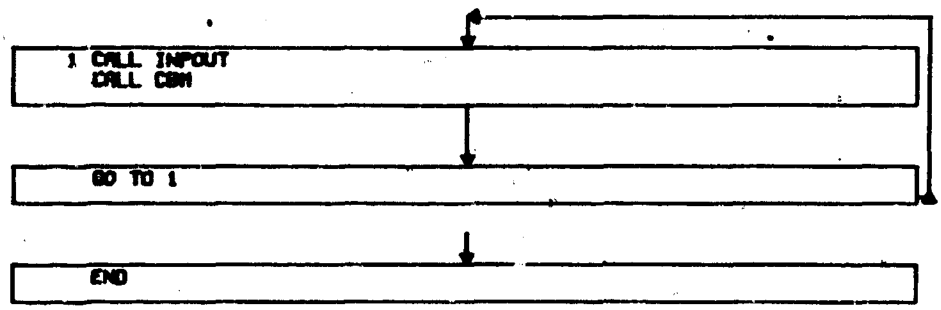
VARIABLE NAME	DESCRIPTION	UNITS
T2	TEMPERATURE OF NODE BELOW OR ABOVE CURRENT ISOTHERM	DEG R
TATHM(I)	TEMPERATURE OF THE I TH NODE, I=1 IS THE LAST NODE OF MAIN MATERIAL	DEG R
TIL	THE LOWER TEMPERATURE AT AN INTERFACE HAVING CONTACT RESISTANCE	DEG R
TIU	THE UPPER TEMPERATURE AT AN INTERFACE HAVING CONTACT RESISTANCE	DEG R
TU(I)	TEMPERATURE OF THE I TH THERMOCOUPLE OR DEPTH OF ISOTHERM IF ONLY ONE LOCATION OCCURS	DEG R OR IN

SECTION 3

FLOW CHARTS

Computer generated flow charts were produced and are given in this section. The flow charts show transfers as lines on the right edge of the figures and DO-loop blocks as lines on the left edge of the figures. The order of presentation corresponds to that used in Section 2 for Fortran variables name definitions.

MAINLINE PAGE NO 1



```
      SUBROUTINE CBM
C     CHARRING MATERIAL THERMAL RESPONSE AND ABLATION PROGRAM ALLOWING
C     FOR UP TO FIVE DECOMPOSING BACK-UP MATERIALS
C     *****   SEE  CBM   LISTING FOR  COMMON      STATEMENTS   *****
C     *****                           DIMENSION   STATEMENTS   *****
C     *****                           EQUIVALENCE STATEMENTS   *****
C     *****                           FORMAT      STATEMENTS   *****
C
C
      DNCP(3)=99999.
      KSCT=17
      SIG=.481E-12
C     CHAR AND PYROLYSIS ZONE CRITERIAL DENSITIES
      DNCP(1)=RHO(2)+CHCRI*(RHO(1)-RHO(2))
      DNCP(2)=RHO(2)+PYCRI*(RHO(1)-RHO(2))
C
C     INITIAL VALUES FOR TIME LOOP
C
 1390 ITER=-1
      DTHC=DTHB
      IAB=0
      ITS=0
      SA=0.0
      SNET=0.
      GSMT=0.0
      GSM2T=0.
      GSMS=0.
      CMD=0.0
      RSU=ABS(RSV)
      GS=0.0
      CMFL=0.0
      CMT=0.
      DSDTB=0.0
      DSDT=0.
      DSI=0.
      DIDT=0.
      CPE(1)=0.
      CPE(2)=0.
      COLD=0.
      POLD=0.
      DCDT=0.
      DPDT=0.
      QCOND=0.
      QCONV=0.
      QCHEM=0.
      RAD=0.
      QRP=0.
      QCONVT=0.
      QRPT=0.
      RADT=0.
      QCHEMT=0.
      QCONDT=0.
      PGPUT=0.
      DECOMT=0.
      QEDTT=0.
      QLOSST=0.
      TT=0.
      TB=0.
      SCEGR=0.
      GSEGR=0.
      PGPU=0.
      DECOM=0.
      EGO=0.
      HW=0.
      BR=0.
      KK=0
      TH=THZRO
      DTA=0.0
      THDS=THZRO-DTHIN
      THPRT=TH
      REWIND KSCT
      CALL LCOUNT (-2,LCT,NPG,RECORD(95))
      WRITE (KOUT,542)
      IS=0
      DTH=DTHIN
```

```
      DELCR=AMIN1(DEL(1),DELM)/5.0
      TSAVE=TA(1)+1.0
      FA=(1.-PSIA)*BA*(RHOOA**(1.-PSIA))
      FB=(1.-PSIB)*BB*(RHOOB**(1.-PSIB))
      FC=(1.-PSIC)*BC*(RHOOC**(1.-PSIC))
      REX=(1.0-.2*BREX)/(1.-BREX)
C
C     BEGINNING OF TIME LOOP
C
```

```
  410 ITER=ITER+1
C
C     CALCULATION OF NODAL PROPERTIES
C
```

```
      DO 108 N=2,NL
```

```
  108 RA(N-1)=RA(N-1)+DSI
```

```
      RA(NL)=RA(NL)+DSI/2.
      CALL OGLE(NL,RA,RR,NUMN,RAV,AREA,EMA)
      ASU=RR(1)
      J=1-JFH-JF
```

```
  100 DO 105 N=1,NL
```

```
      J=J+JF
      RR(N)=RR(N)/ASU
      CALL LOOK (3,TA(N),TT2,TCP,TKP,THZ,0,Y2,Y2(4),3)
      CN(N)=Y2(2)
      CPV(N)=Y2(1)
      HP(N)=Y2(3)+DH1
      CALL LOOK (4,TA(N),TT2(1,2),TCP(1,2),TKP(1,2),THZ(1,2),0,Y2,D2,3)
      CNC(N)=Y2(2)
      CPC(N)=Y2(1)
      HC(N)=Y2(3)+DH2
```

```
      IF (MATL(N)-1) 103,101,102
```

```
  101 X(N)=1.
      CP(N)=CPV(N)
      H(N)=HP(N)
      RO(N)=RHO(1)
      ROT(N)=RHO(1)
```

```
      GO TO 106
```

```
102 X(N)=0.
    CN(N)=Y2(2)
    H(N)=HC(N)
    CP(N)=CPC(N)
    RO(N)=RHO(2)
    ROT(N)=RHO(2)

    GO TO 105

103 X(N) = PETE-PET/RO(N)
    H(N)=X(N)*HP(N)+(1.-X(N))*HC(N)
    CP(N)=X(N)*CPV(N)+(1.-X(N))*CPC(N)

    IF(N-1) 109,109,104

109 ROT(1)=GAMA*(ROA(1)+ROB(1))+OMG*ROC(1)

    GO TO 105

104 ROT(N)=(ROA(J)+ROB(J))*GAMA+OMG*(ROC(J))

105 CONTINUE

    IF (ITER) 1050,1050,1051

1050 RAT(NL)=DEL(NL)/(RR(NL)*(CN(NL)*X(NL)+CNC(NL)*(1.0-X(NL))))

1051 CONTINUE

    IF (NDBU) 7419,7419,7412

7412 DO 740  L=1,NDBU

        LL=NFI(L)
        LU=NLA(L)
```

```
      N=2*L-1

      DO 741     I=LL.LU

      CALL LOOK(20+2*L.TA(I).TT5(1.N).TCBU(1.N).TKBU(1.N).TENT(1.N)
     C   . 0.Y2.D2.3)
         CN(I)=Y2(2)
         CPV(I)=Y2(1)
         HP(I)=Y2(3)+DHV(L)
      CALL LOOK(21+2*L. TA(I). TT5(1.2*L). TCBU(1.2*L). TKBU(1.2*L).
     C     TENT(1.2*L). 0.Y2.D2.3)
         CNC(I)=Y2(2)
         CPC(I)=Y2(1)
         HC(I)=Y2(3)+DHC(L)
         H(I)=X(I)*HP(I)+(1.0-X(I))*HC(I)
         RR(I)=AREA(I)/ASU

      IF(ITER) 741.7411.741

 7411 RO(I)=X(I)*RHOV(L)+(1.0-X(I))*RHOC(L)
      RON(I)=RO(I)
      RAT(I)= DEL(I)/(RR(I)*(CN(I)*X(I) + CNC(I)*(1.0 -X(I))))

  741    CP(I)=X(I)*CPV(I)+(1.0-X(I))*CPC(I)

  740 CONTINUE

 7413 IF(NUMN-NBM2) 112.106.106

  106 DO 107 N=NBM2.NUMN

      RR(N)=AREA(N)/ASU
      KT=MATL(N)
      CALL LOOK(KT+2. TA(N). TT2(1.KT). TCP(1.KT). TKP(1.KT).0.0.Y2.D2.2)
      CP(N)=Y2(1)
      CN(N)=Y2(2)
      RAT(N)=DEL(N)/(CN(N)*RR(N))

  107 RO(N)=RHO(KT)

  112 HRES=SIB*EPSH*(TA(NUMN)+TRES)*(TA(NUMN)**2+TRES**2)+HCONV
```

```
      RAT(NUMN+1)=1./(HRES*RR(NUMN)+.00000001)
      QLOSS=(TA(NL)-TA(NBM))/(0.5*(RAT(NL)+RAT(NBM))+RC(NL)/RR(NL))
      QLOSST=QLOSST+QLOSS*DTH/AREA(1)*ASU
      CMT=CMT+RHO(2)*DSDT*ASU/AREA(1)*DTH
      DEL(NUMN + 1) = CN(NUMN)/(HRES + 0.00000001)
      RR(NUMN+1)=RR(NUMN)
      DTHO=DTH
      DTS=TSAVE-TA(1)
```

```
      IF(ITER) 151,606,151
```

```
C
C     OUTPUT
C
```

```
  151 CALL SSWTCH(4,KKSW)
```

```
      GO TO (3000,750),KKSW
```

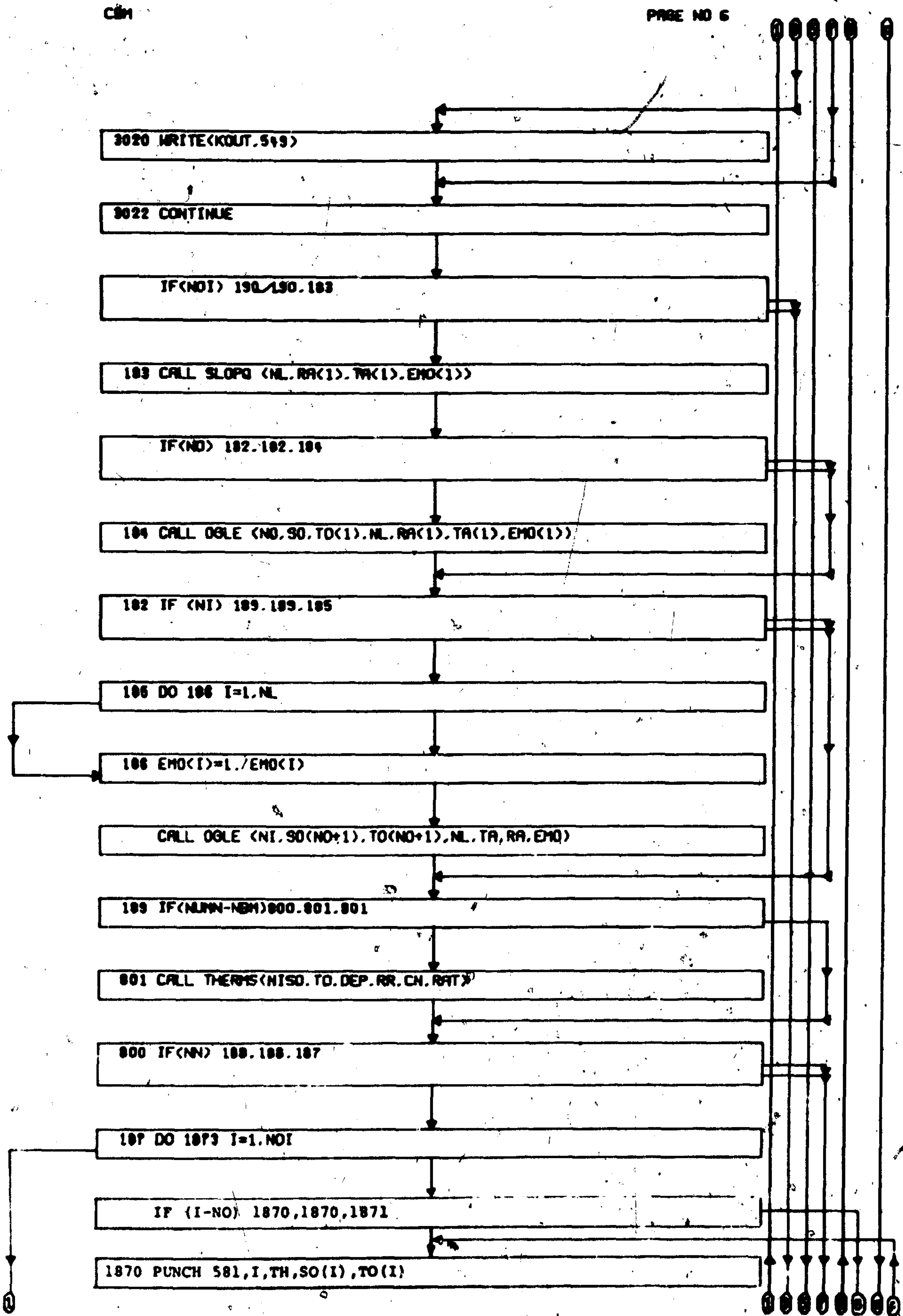
```
  750 IF (TH-THPRT+.00001) 4410,3000,3000
```

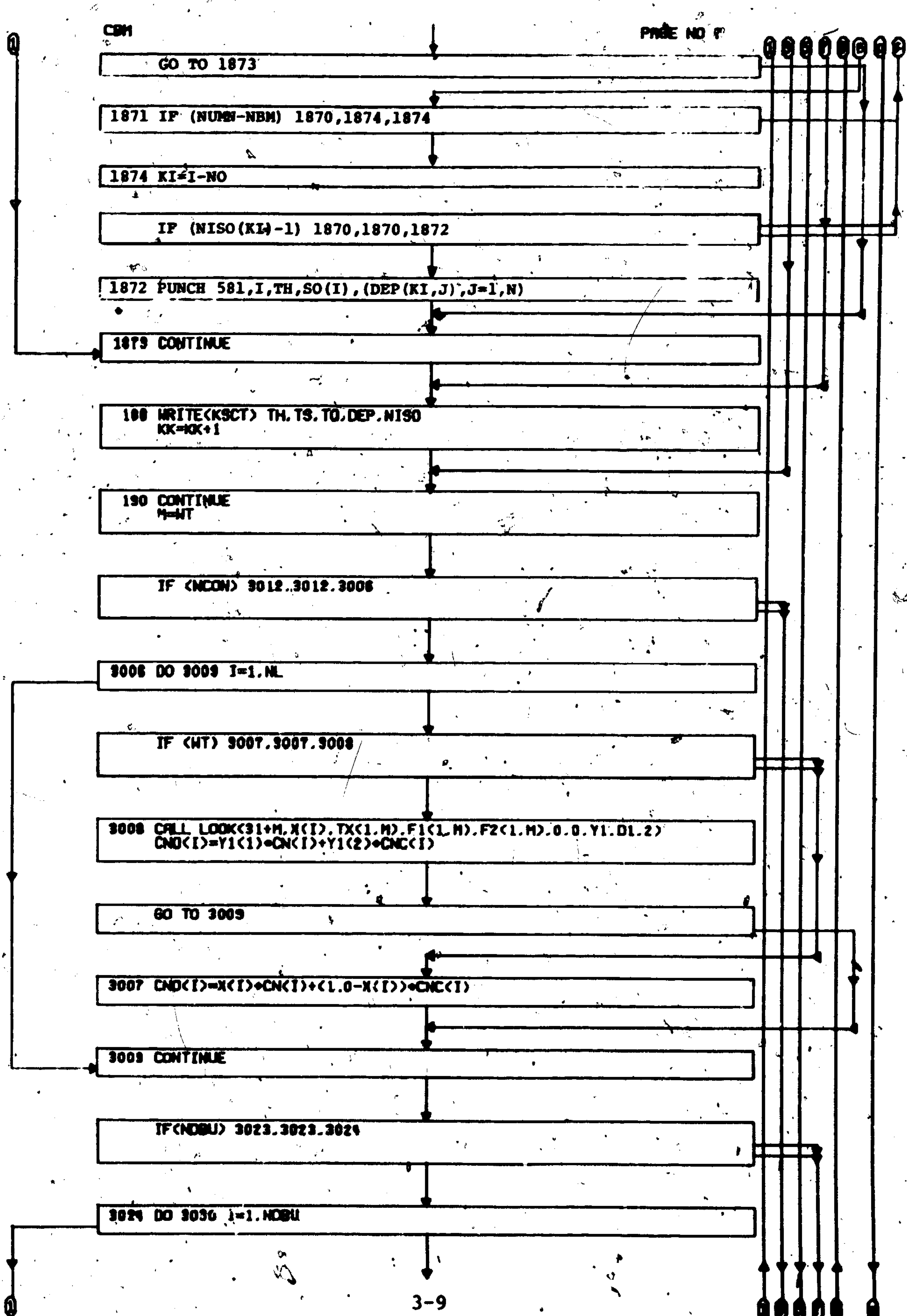
```
 3000 DIDT=12.0*DSDTB
      NDR=NBM-NL-1
      NLI=(NUMN-NDR+1)/2
      K=NLI
      CALL LCOUNT(33+NLI,LCT,NPG,RECORD(35))
  322 WRITE (KOUT,543)TH
      WRITE (KOUT,544)
      WRITE (KOUT,545) ITER,ITS,II   ,RSU,HW,HE,CH,BR
      WRITE (KOUT,546)
      WRITE (KOUT,547)
      BPRM=(GS  +CMD)/(CH*CMH)
      BPRMG=GS  /(CH*CMH)
      WRITE (KOUT,548) BPRM,BPRMG,CMD,GSMS,CMT,GSMT
      WRITE (KOUT,5480) CHCRI,PYCRI
      WRITE (KOUT,5481) SA,DIDT,CPE(1),DCDT,CPE(2),DPDT
      WRITE (KOUT,5482)
 3224 WRITE (KOUT,5483) QCONV,QRP,RAD,QCHEM,QCOND,QCONVT,QRPT,RADT,QCHEM
     1T,QCONDT
      WRITE (KOUT,5484)
      WRITE (KOUT,5485)PGPU,DECOM, TB,DEDT,QLOSS,PGPUT,DECOMT, TT,DEDTT,
     1QLOSST
```

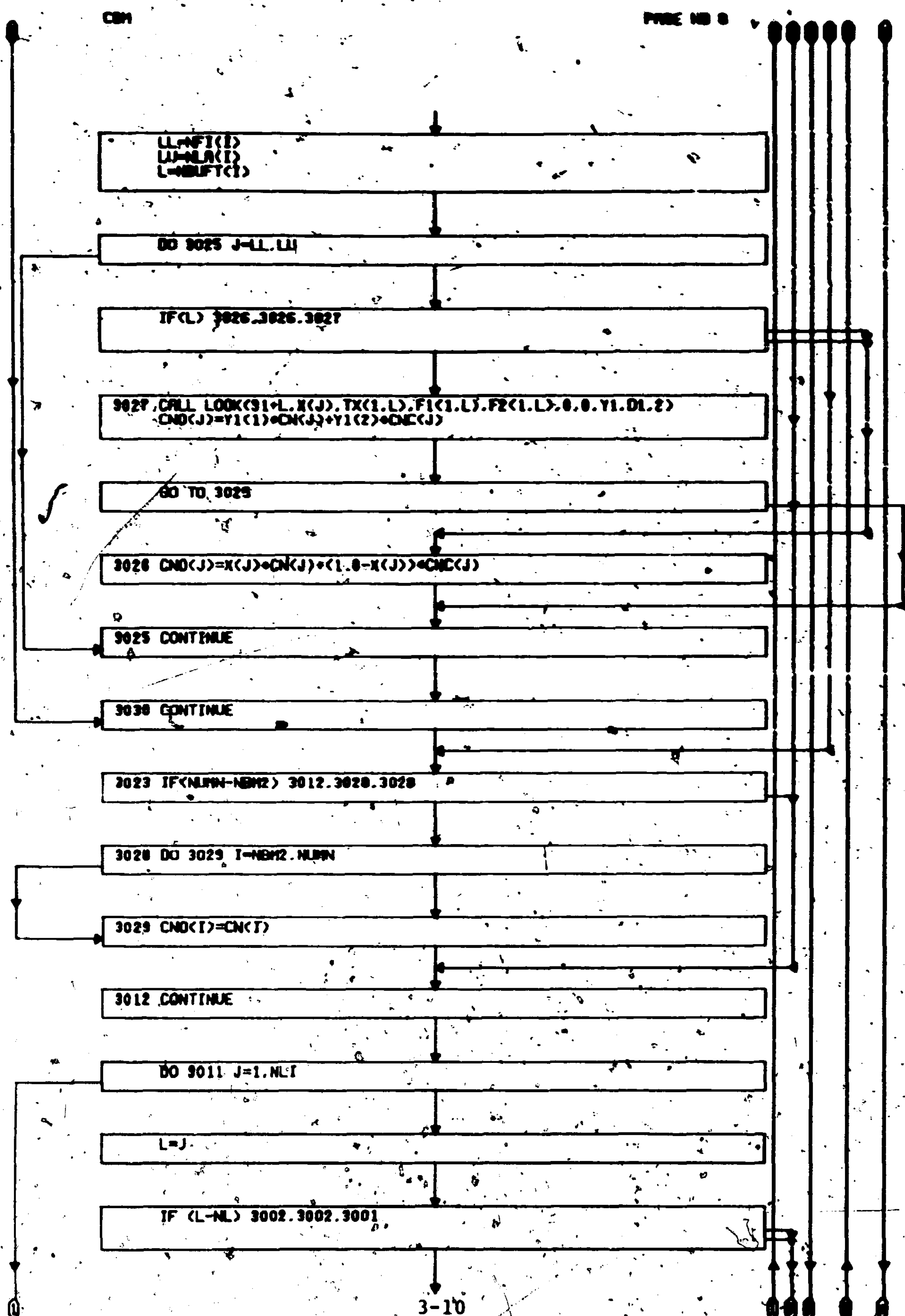
```
      IF (NCON) 3020,3020,3021
```

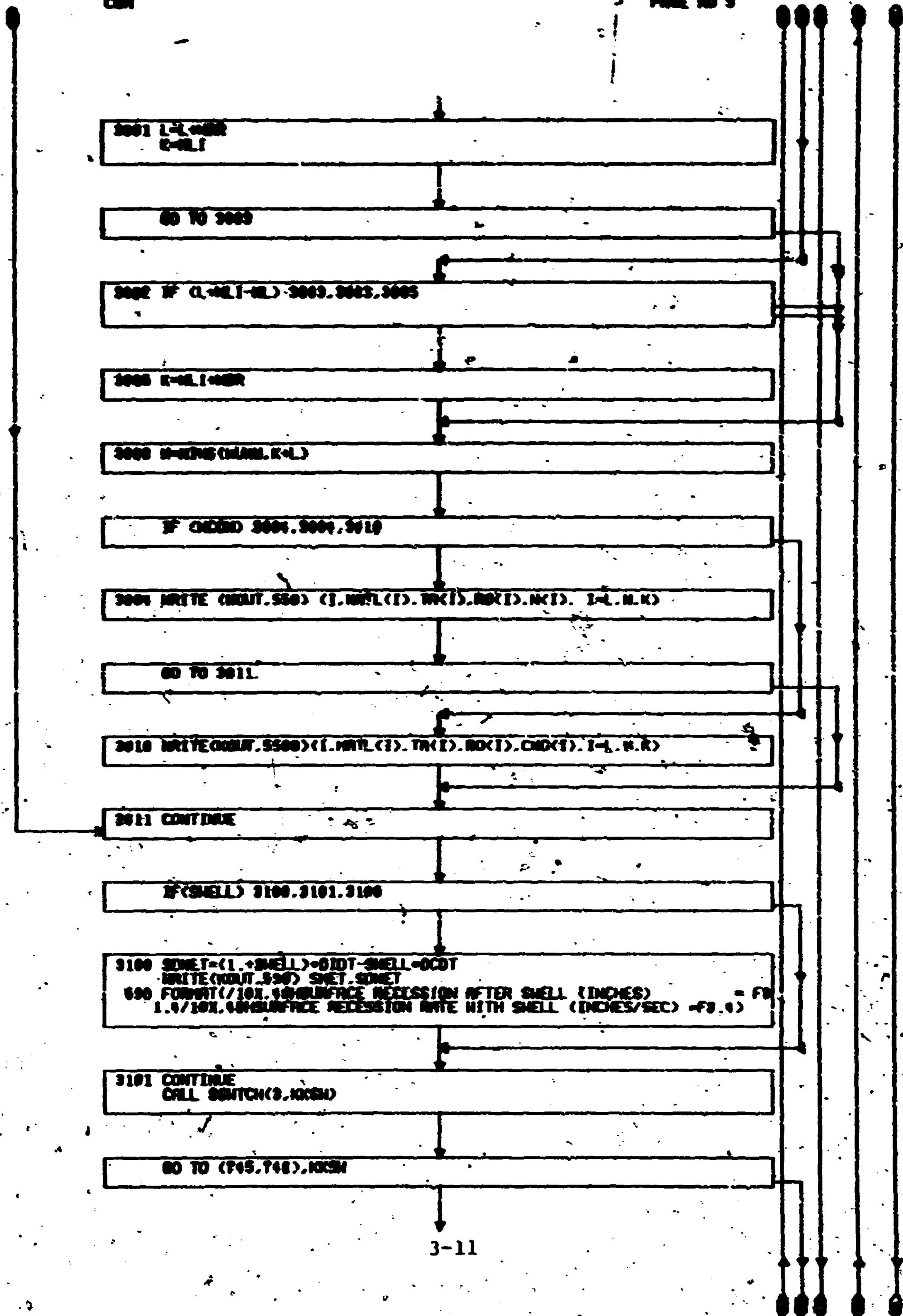
```
 3021 WRITE(KOUT,5490)
```

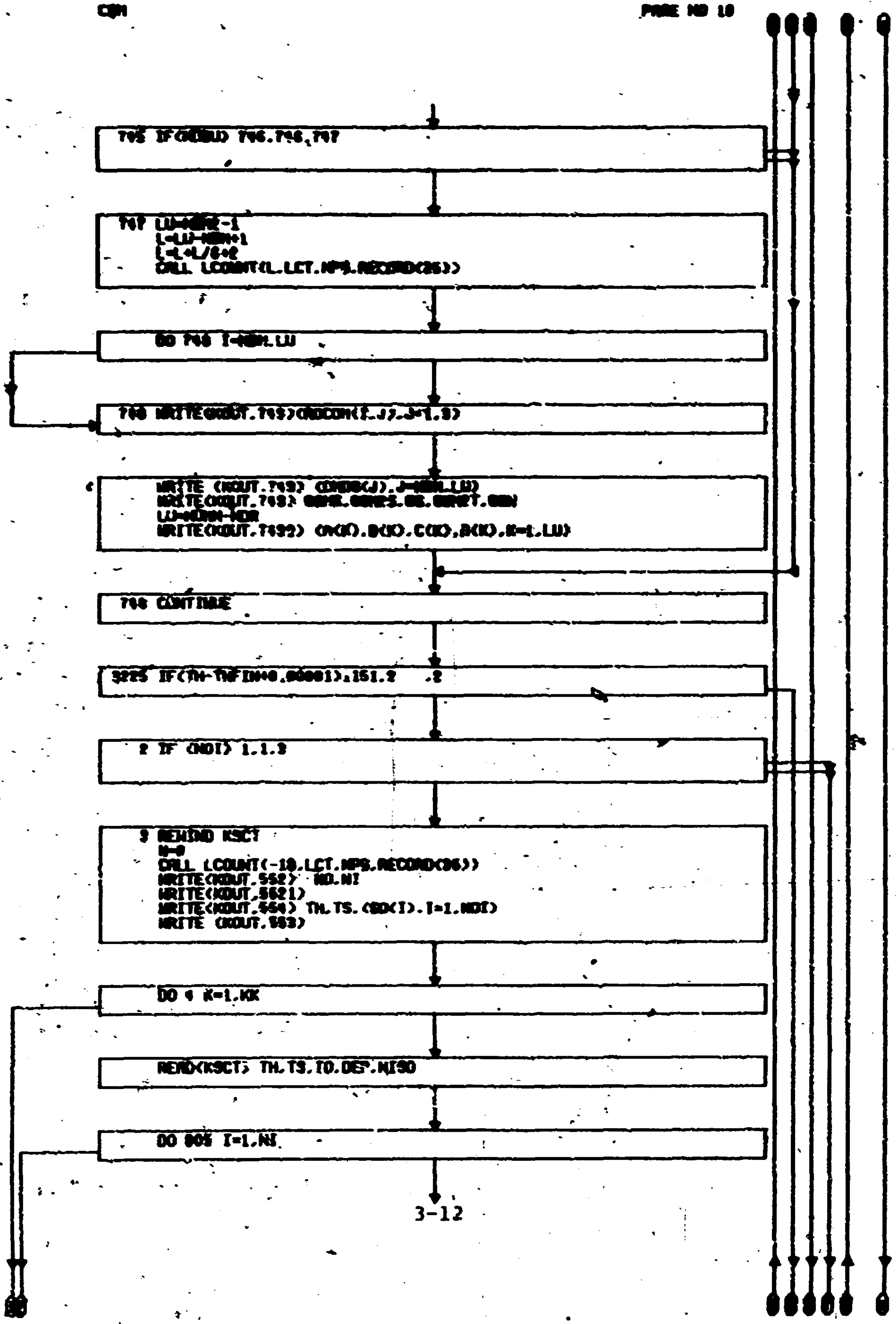
```
      GO TO 3022
```

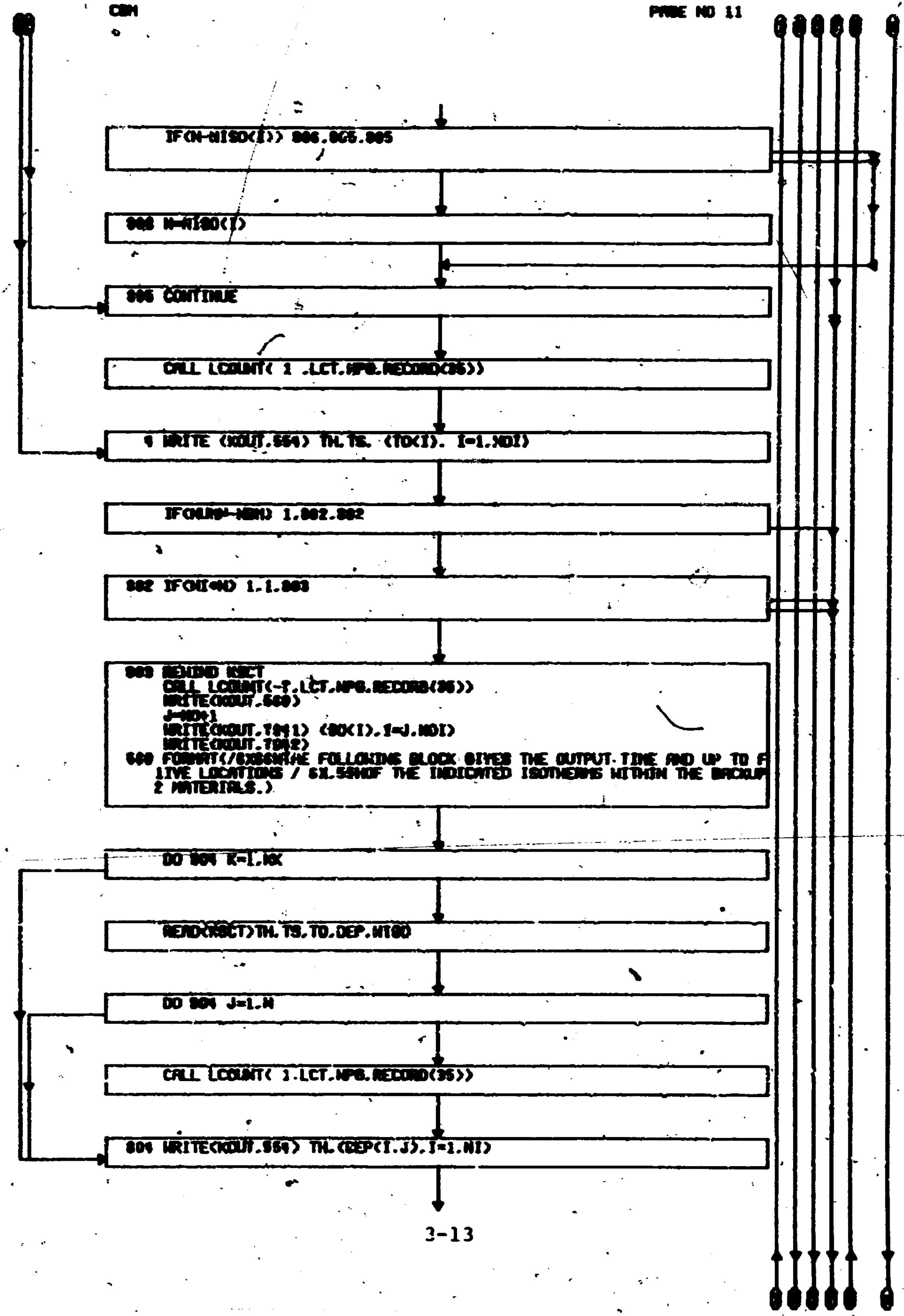

3020 WRITE(KOUT,549)
3022 CONTINUE
IF(NOI) 190,190,183
183 CALL SLOPQ (NL,RA(1),TA(1),EMO(1))
IF(NO) 182,182,184
184 CALL OGLE (NO,SO,TO(1),NL,RA(1),TA(1),EMO(1))
182 IF (NI) 189,189,185
185 DO 186 I=1,NL
186 EMO(I)=1./EMO(I)
CALL OGLE (NI,SO(NO+1),TO(NO+1),NL,TA,RA,EMO)
189 IF(NUMN-NBM)800,801,801
801 CALL THERMS(NISO,TO,DEP,RR,CN,RAT)
800 IF(NN) 188,188,187
187 DO 1873 I=1,NOI
IF (I-NO) 1870,1870,1871
1870 PUNCH 581,I,TH,SO(I),TO(I)


CBM
PAGE NO
GO TO 1873
1871 IF (NUMN-NBM) 1870,1874,1874
1874 KI=I-NO
IF (NISO(KI)-1) 1870,1870,1872
1872 PUNCH 581,I,TH,SO(I),(DEP(KI,J),J=1,N)
1873 CONTINUE
188 WRITE(KSCT) TH.TS.TO.DEP.NISO
KK=KK+1
190 CONTINUE
M=WT
IF (NCON) 3012..3012.3006
3006 DO 3009 I=1.NL
IF (WT) 3007.3007.3008
3008 CALL LOOK(31+M.X(I).TX(1.M).F1(1.M).F2(1.M).0.0.Y1.D1.2)
CND(I)=Y1(1)*CN(I)+Y1(2)*CNC(I)
GO TO 3009
3007 CND(I)=X(I)*CN(I)+(1.0-X(I))*CNC(I)
3009 CONTINUE
IF(NOBU) 3023.3023.3024
3024 DO 3030 I=1.NOBU


CBM
PAGE NO 8
LL=NFI(I)
LU=NLA(I)
L=NBUFT(I)
DO 3025 J=LL.LU
IF(L) 3026.3026.3027
3027 CALL LOOK(31+L.X(J).TX(1.L).F1(1.L).F2(1.L).0.0.Y1.D1.2)
CNO(J)=Y1(1)*CN(J)+Y1(2)*CNC(J)
GO TO 3025
3026 CNO(J)=X(J)*CN(J)+(1.0-X(J))*CNC(J)
3025 CONTINUE
3030 CONTINUE
3023 IF(NUMN-NBM2) 3012.3028.3028
3028 DO 3029 I=NBM2.NUMN
3029 CNO(I)=CN(I)
3012 CONTINUE
DO 3011 J=1.NLI
L=J
IF (L-NL) 3002.3002.3001


3001 L=L+NBR
K=NLI
GO TO 3003
3002 IF (L+NLI-NL) 3003,3003,3005
3005 K=NLI+NBR
3003 N=MINO(NLNL,K+L)
IF (NCOND) 3004,3004,3010
3004 WRITE (KOUT,550) (I,MATL(I),TA(I),RO(I),N(I), I=L,N,K)
GO TO 3011
3010 WRITE(KOUT,5500)(I,MATL(I),TA(I),RO(I),CND(I),I=L,N,K)
3011 CONTINUE
IF(SWELL) 3100,3101,3100
3100 SDNET=(1.+SWELL)*DIDT-SWELL*DCDT
WRITE(KOUT,590) SNET,SDNET
590 FORMAT(//10X,60HSURFACE RECESSION AFTER SWELL (INCHES) = F9
1.4/10X,60HSURFACE RECESSION RATE WITH SWELL (INCHES/SEC) =F8.4)
3101 CONTINUE
CALL SWITCH(3,KKSW)
GO TO (745,740),KKSW


768 CONTINUE
3225 IF(TH-TNFIN+0.00001),151.2 .2
2 IF (NDI) 1.1.3
3 REWIND KSCT
CALL LCOUNT(-10.LCT.NPS.RECORD(36))
WRITE(KOUT.552) ND.NI
WRITE(KOUT,5521)
WRITE(KOUT.554) TH.TS.(SD(I).I=1.NDI)
WRITE (KOUT.553)
DO 4 K=1.KK
DO 805 I=1.NI


IF(N-NISO(I)) 806.805.805
806 N=NISO(I)
805 CONTINUE
CALL LCOUNT(1 .LCT.NPB.RECORD(35))
4 WRITE (KOUT.554) TH.TS. (TO(I). I=1.NDI)
IF(NUM-NEM) 1.802.802
802 IF(NI-N) 1.1.803
803 REWIND KSCT
CALL LCOUNT(-1.LCT.NPB.RECORD(35))
WRITE(KOUT.560)
J=NDI+1
WRITE(KOUT.7041) (DO(I).I=J.NDI)
WRITE(KOUT.7042)
560 FORMAT(/6X66HTHE FOLLOWING BLOCK GIVES THE OUTPUT TIME AND UP TO F
1IVE LOCATIONS / 6X.55HOF THE INDICATED ISOTHERMS WITHIN THE BACKUP
2 MATERIALS.)
DO 804 K=1.KK
READ(KSCT)TH.TS.TO.DEP.NISO
DO 804 J=1.N
CALL LCOUNT(1.LCT.NPB.RECORD(35))
804 WRITE(KOUT.554) TH.(DEP(I.J).I=1.NI)

```
      GO TO 1
 1161 IF(TH-TPR2+0.00001)  154,150,150
  150 DTPRT=DTPR2
      DTPR2=DTPR3
      TPR2=TPR3
      TPR3=THFIN
  154 CONTINUE
      IF(TH-THPRT+.00001) 743,742,742
  742 THPRT=AMIN1(THPRT+DTPRT,TPR2)
  743 CONTINUE
 4418 DTH=AMIN1(DTH0,DELCR/(DSDTB+.0000001),TH-THOS, 50.0/(ABS(TSAVE-TR(
     1 1))+.1)*DTH)
      TSAVE=TR(1)
      DTH=(THPRT-TH)/(AINT((THPRT-TH)/DTH+1.0))
  144 TH=TH+DTH
C
C     FUNCTIONS OF TIME
  606 I=IR(1)
      VF=VFZ
  601 IF(TTH(I+1)-TH+0.00001) 614,604,604
  614 IF(I+1-IHI(1)) 602,604,604
  602 I=I+1
      IF(TTH(I+1)-TTH(I)) 601,603,601
```

```
603 TH=TH-DTH
    THDS=TTH(I)-DTMIN
    DTH=AMAX1(DTMIN,TTH(I)-TH)
    TH=TH+DTH

    GO TO 601

604 DEN=(TH-TTH(I))/(TTH(I+1)-TTH(I))

    IF (TTH(I+1)-TTH(I)) 6040,6040,605

6040 DEN=0.

605 CH=TCH(I)+DEN*(TCH(I+1)-TCH(I))
    GRA=TGR(I)+DEN*(TGR(I+1)-TGR(I))
    PRES=TPI(I)+DEN*(TPI(I+1)-TPI(I))
    HE=THE(I)+DEN*(THE(I+1)-THE(I))
    BRP=TBRP(I)+DEN*(TBRP(I+1)-TBRP(I))
    II=1

    IF(CH) 6001,6001,600

6001 II=2
    CH=0.0

    IF (HE-2.) 6002,6002,600

6002 II=3
    VF=HE
    HE=0.

600 IR(1)=I

    IF(ITER) 610,113,610

113 DEDT=0.
    ITER=1
```

```
      GO TO 3000

  610 IF(DTH-.000001) 162,162,608

  162 WRITE (KOUT,582) TH,DTH,DTHS,DTHB,THDS,DTS,DELCR,DSDTB
      TH=THFIN

      GO TO 3000

C
C     INTERNAL DECOMPOSITION  --  DENSITY CALCULATION

  608 N=-JFH
C
C     SPECIFY SURFACE CHANGES DURING THIS TIME INTERVAL
      DSDT=DSDTB
      DS=DSDT*DTH
      DSI=12.0*DS
      SA=SA+DSI
      RSU=ABS(RSV+SA)
      DTHB=DTHC
      DEL(NL)=DEL(NL)-DS
      FK=0.0
      FJF=FJFH
      J1=JFHP
      DENOLD=RHO(2)
      COLD=CPE(1)
      POLD=CPE(2)
      CPE(1)=RA(NL)+6.*DEL(NL)
      CPE(2)=CPE(1)
      IE=1
      ROOZ=0.0
      ISV=MATL(NL+1)
      MATL(NL+1)=MATL(NL)
      TA(NL+1)=TA(NBM)
      DEL(NL+1)=DEL(NBM)
      RR(NL+1)=RR(NBM)

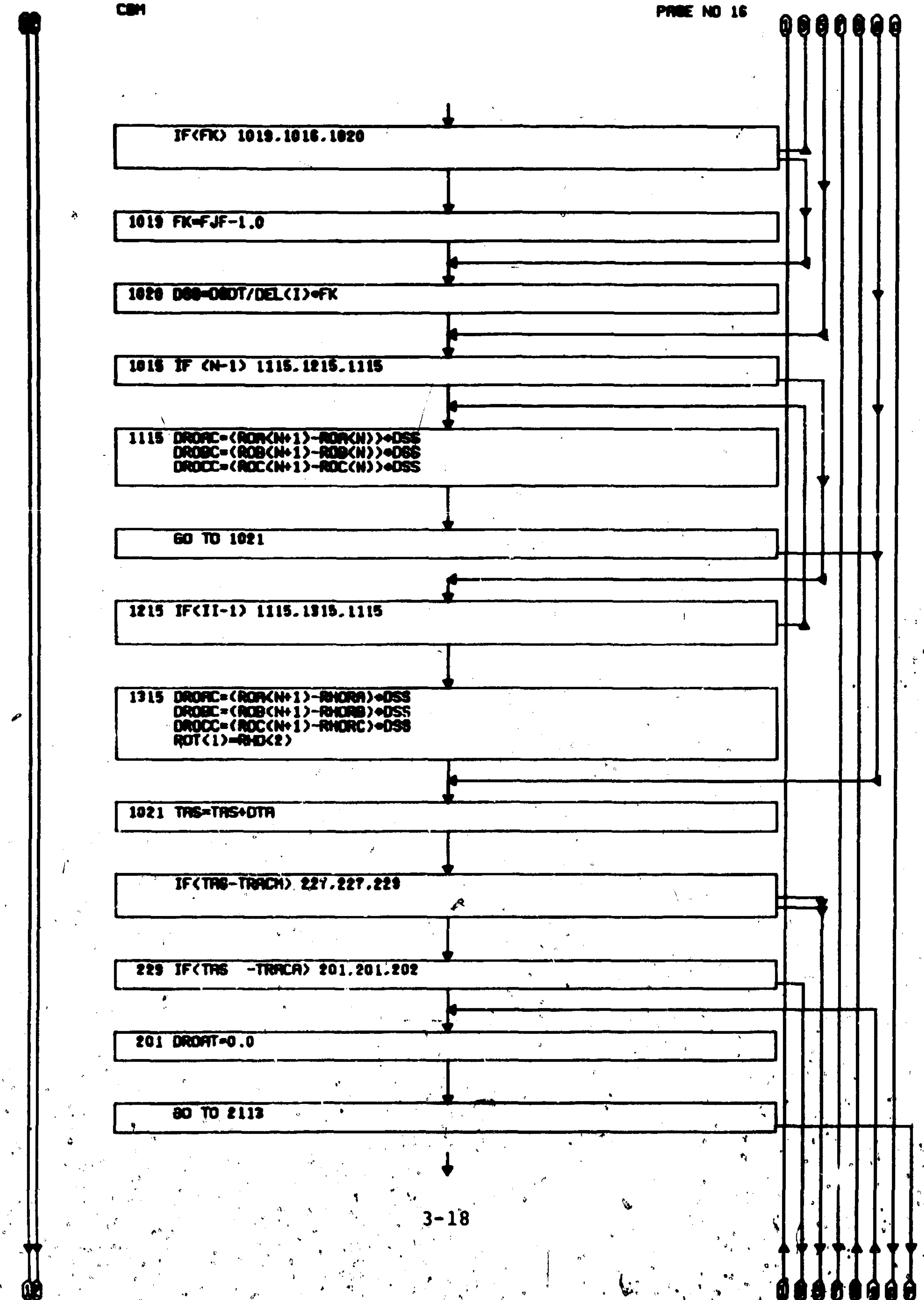
      DO 252 I=1,NL

      DHDB(I)=0.0
      RON(I)=ROOZ
      DSS=FJF/DEL(I)*DSDT

  163 DO 255 J=J1,JF

      N=N+J1-1
```

```
      IF (J-JFHP) 253,259,253
259   IF (MATL(I)+MATL(I+1)-4) 263,260,263
263   IF(AMAX1(TA(I),TA(I+1))-TRACH)261,261,262
261   IF (MATL(I)+MATL(I)+MATL(I+1)-3) 262,260,262
260   J1=JFHP
      ROOZ=FJFH*RO(I+1)
      RON(I)=RON(I)+FJFH*RO(I)
      N=N+JFH
      GO TO 264
262   ROOZ=0.0
      DTA=(TA(I+1)-TA(I))/(FJFS+FJF/DEL(I)*DEL(I+1)/RR(I)*RR(I+1))
      J1=1
      TAG=TA(I)
253   N=N+1
      IF(ABS(DSG)-.000001) 1016,1016,1017
1016  DRDAC=0.
      DRDBC=0.
      DRDCC=0.
      GO TO 1021
1017  IF(I-NL) 1015,1018,1015
1018  FK=FK-1.0
```


IF(FK) 1019.1016.1020
1019 FK=FJF-1.0
1020 DSS=DSDT/DEL(I)*FK
1016 IF (N-1) 1115.1215.1115
1115 DROAC=(ROA(N+1)-ROA(N))*DSS
DROBC=(ROB(N+1)-ROB(N))*DSS
DROCC=(ROC(N+1)-ROC(N))*DSS
GO TO 1021
1215 IF(II-1) 1115.1315.1115
1315 DROAC=(ROA(N+1)-RHORA)*DSS
DROBC=(ROB(N+1)-RHORB)*DSS
DROCC=(ROC(N+1)-RHORC)*DSS
ROT(1)=RHO(2)
1021 TAS=TAS+DTA
IF(TAS-TRACM) 227.227.229
229 IF(TAS -TRACA) 201.201.202
201 DROAT=0.0
GO TO 2113

```
202  IF(RHORA-ROA(N)) 211,201,201

211  RD=ROA(N)-RHORA
     POW=1.-PSIA

     IF(POW)2111,2112,2111

2111 DROAT=(-RD+((RD**POW)-                FA*EXP(-EA/TAS)*DTH)**
     1(1./POW))/DTH

     GO TO 2113

2112 DROAT=RD*(EXP(-BA*DTH*EXP(-EA/TAS))-1.)/DTH

2113 ROA(N)=ROA(N)+(DROAT+DROAC)*DTH

     IF(ROA(N)-RHORA) 2114,221,221

2114 ROA(N)=ROA(N)-(DROAT+DROAC)*DTH
     DROAT=(RHORA-ROA(N))/DTH-DROAC
     ROA(N)=RHORA

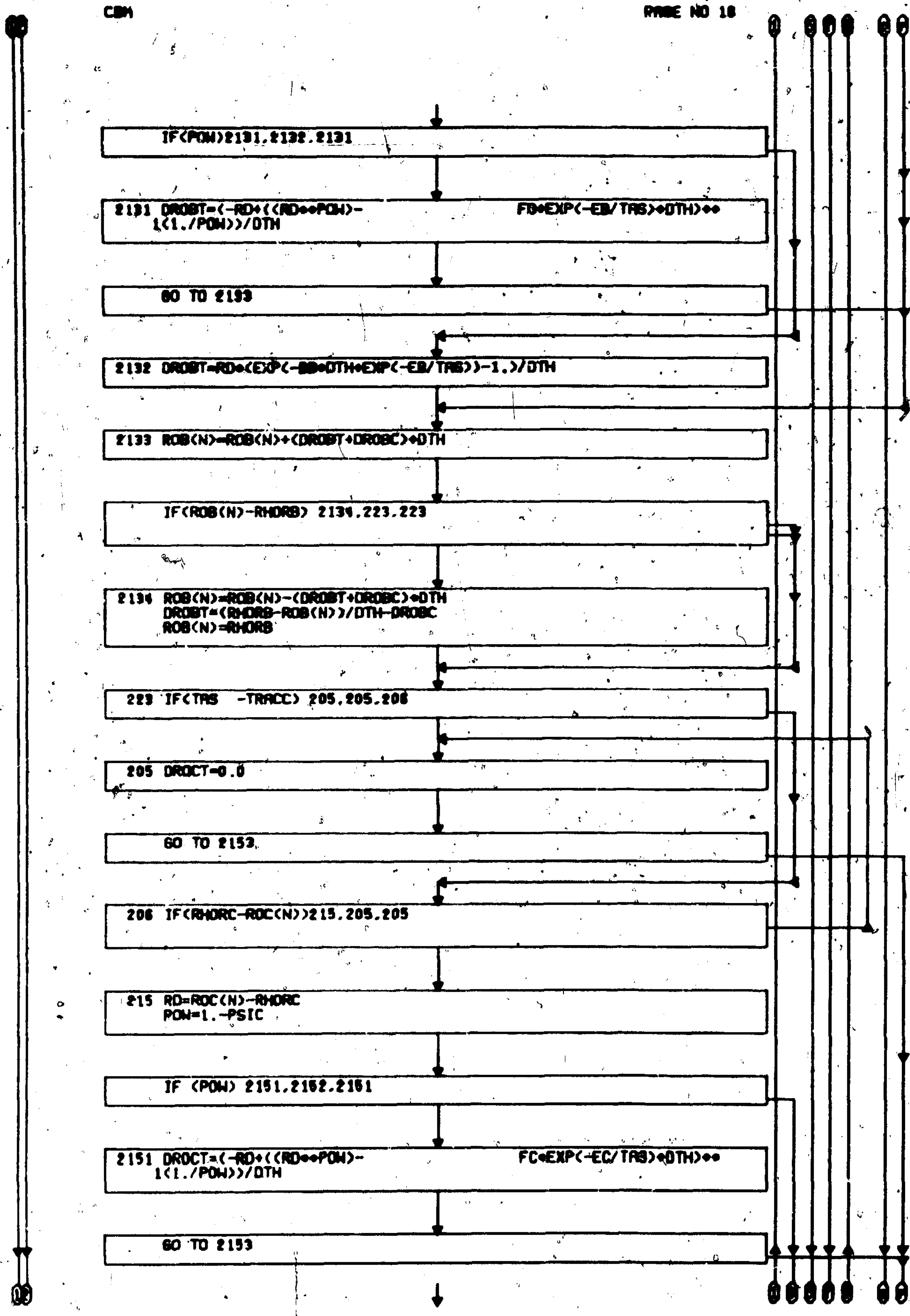
221  IF(TAS  -TRACB)203,203,204

203  DROBT=0.0

     GO TO 2133

204  IF(RHORB-ROB(N))213,203,203

213  RD=ROB(N)-RHORB
     POW=1.-PSIB
```


IF(POW)2131,2132,2131
2131 DROBT=(-RD+((RD**POW)- FB*EXP(-EB/TAS)*DTH)**
1(1./POW))/DTH
GO TO 2133
2132 DROBT=RD*(EXP(-BB*DTH*EXP(-EB/TAS))-1.)/DTH
2133 ROB(N)=ROB(N)+(DROBT+DROBC)*DTH
IF(ROB(N)-RHORB) 2134,223,223
2134 ROB(N)=ROB(N)-(DROBT+DROBC)*DTH
DROBT=(RHORB-ROB(N))/DTH-DROBC
ROB(N)=RHORB
223 IF(TAS -TRACC) 205,205,206
205 DROCT=0.0
GO TO 2153
206 IF(RHORC-ROC(N))215,205,205
215 RD=ROC(N)-RHORC
POW=1.-PSIC
IF (POW) 2151,2152,2151
2151 DROCT=(-RD+((RD**POW)- FC*EXP(-EC/TAS)*DTH)**
1(1./POW))/DTH
GO TO 2153

```
2152 DROCT=RD*(EXP(-BC*DTH*EXP(-EC/TAS))-1.)/DTH

2153 ROC(N)=ROC(N)+(DROCT+DROCC)*DTH

     IF(ROC(N)-RHORC) 2154,225,225

2154 ROC(N)=ROC(N)-(DROCT+DROCC)*DTH
     DROCT=(RHORC-ROC(N))/DTH-DROCC
     ROC(N)=RHORC

 225 DMDG(I)=DMDG(I)-DEL(I)*((DROAT+DROBT)*GAMA+OMB*DROCT)

 227 DNS=(ROA(N)+ROB(N))*GAMA+OMB*ROC(N)
     RON(I)=RON(I)+DNS

     IF(N-1) 2251,2253,2251

2251 IF(DNS-DNCP(IE)) 2253,2252,2252

2252 CPE(IE)=DEL(I)*((FLOAT(N)-0.5)/FJF+1.-FLOAT(I))*12.+RA(I)

     IF(ABS(DNS-DENOLD)-1.0E-20) 2254,2259,2259

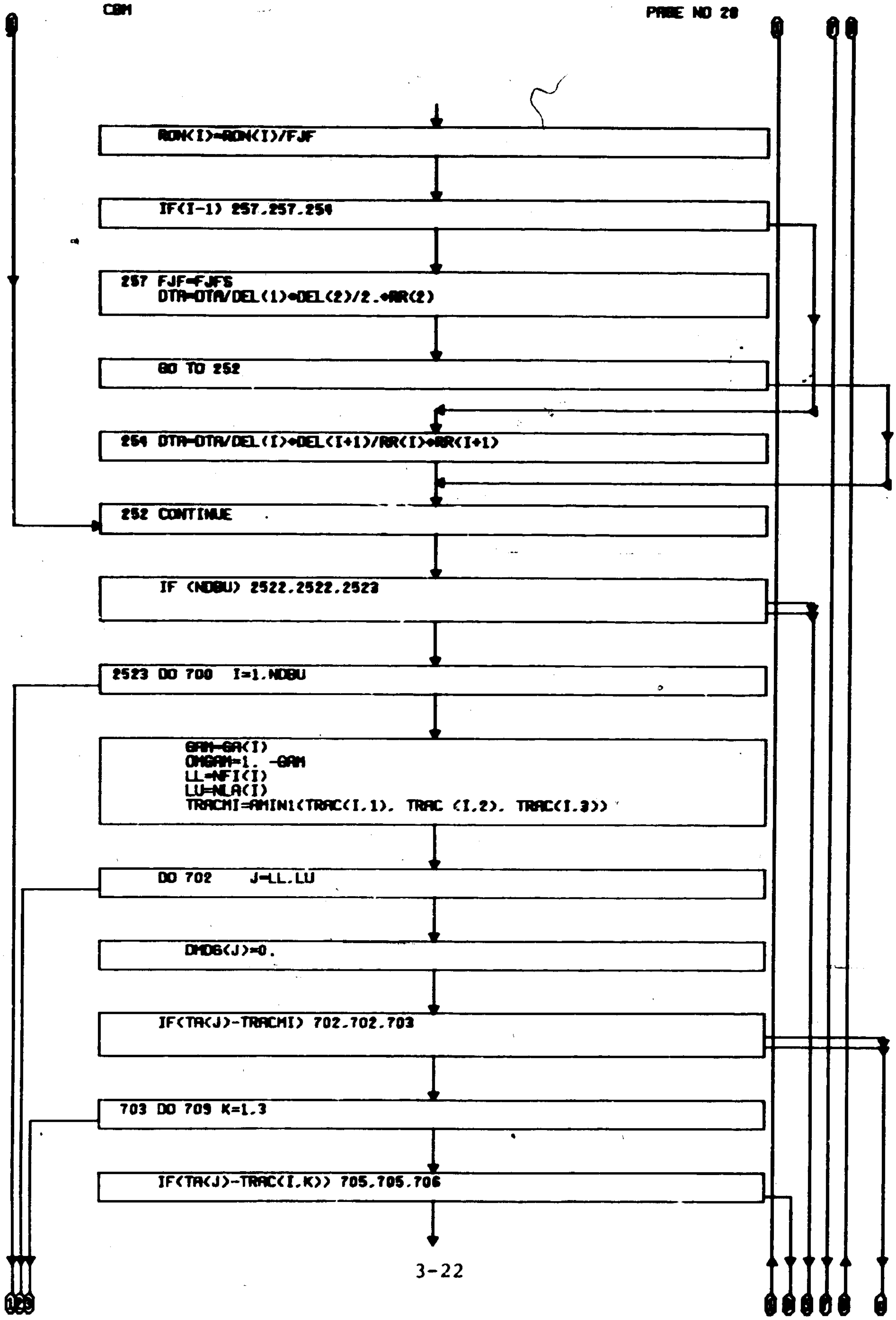
2259 CPE(IE)= CPE(IE)-DEL(I)/(DNS-DENOLD)*(DNS-DNCP(IE))/FJF*12.0

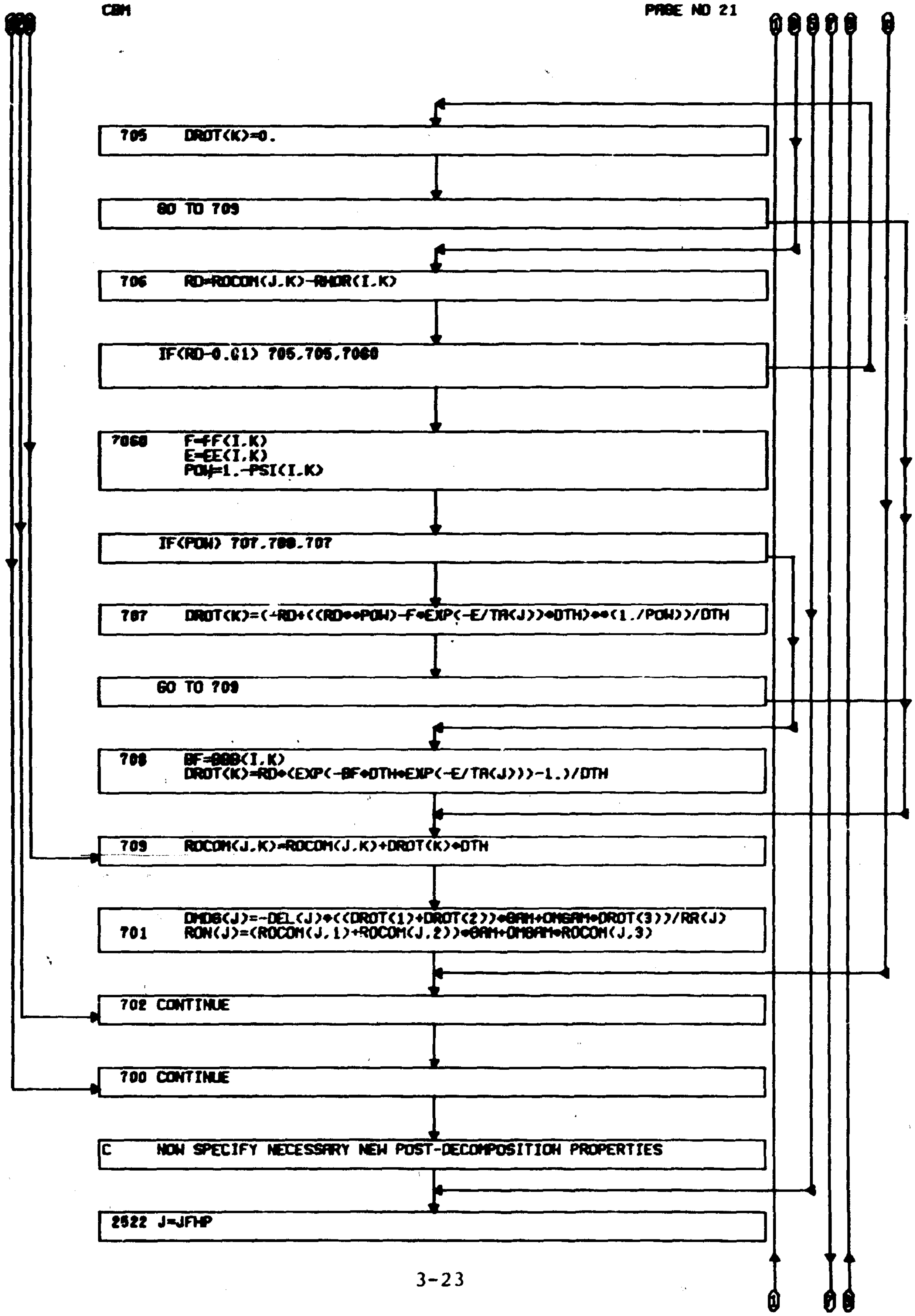
2254 CPE(IE)=AMAX1(CPE(IE),SA)
     IE=IE+1

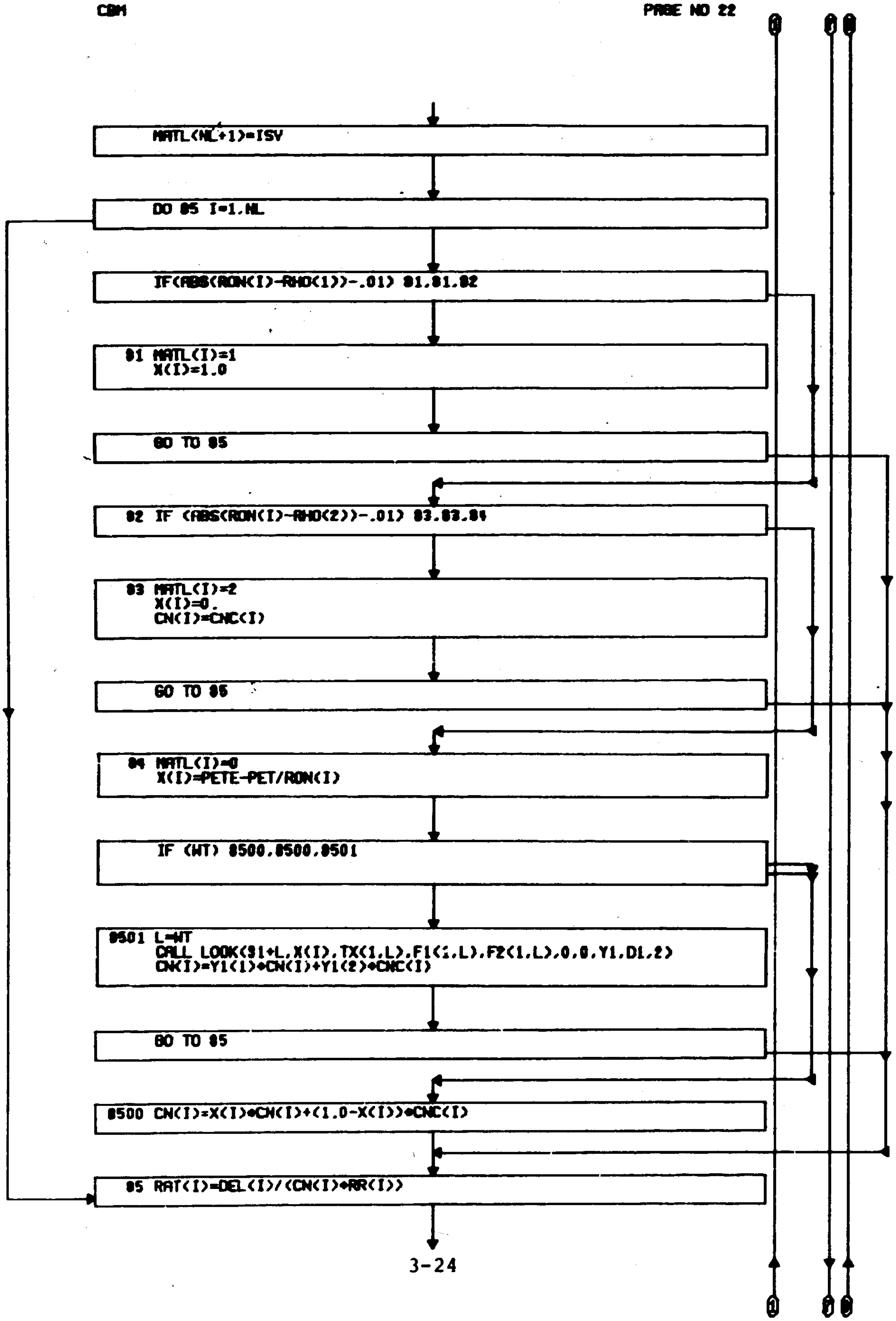
2253 DENOLD=DNS

 255 TAS=TAS+DTA

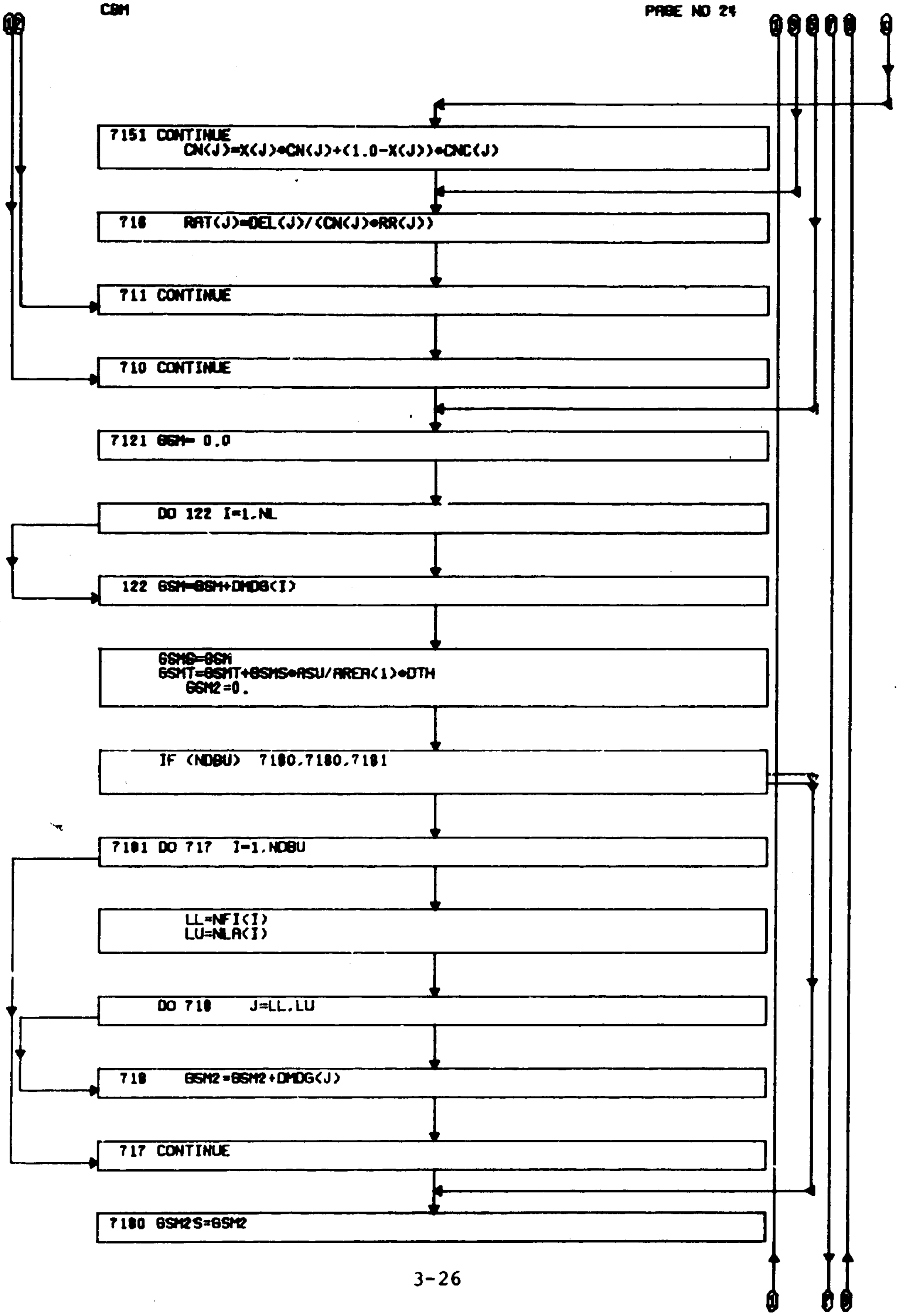
 264 DMDG(I)=DMDG(I)/FJF*RR(I)
```


CBM
PAGE NO 28
RON(I)=RON(I)/FJF
IF(I-1) 257.257.254
257 FJF=FJFS
DTA=DTA/DEL(1)+DEL(2)/2.+RR(2)
GO TO 252
254 DTA=DTA/DEL(I)+DEL(I+1)/RR(I)+RR(I+1)
252 CONTINUE
IF (NDBU) 2522.2522.2523
2523 DO 700 I=1.NDBU
GAM=GA(I)
OMGAM=1. -GAM
LL=NFI(I)
LU=NLA(I)
TRACMI=AMIN1(TRAC(I.1). TRAC (I.2). TRAC(I.3))
DO 702 J=LL.LU
DMDG(J)=0.
IF(TA(J)-TRACMI) 702.702.703
703 DO 709 K=1.3
IF(TA(J)-TRAC(I.K)) 705.705.706


705 DROT(K)=0.
GO TO 709
706 RD=ROCOM(J,K)-RHOR(I,K)
IF(RD-0.01) 705,705,7060
7060 F=FF(I,K)
E=EE(I,K)
POW=1.-PSI(I,K)
IF(POW) 707,708,707
707 DROT(K)=(-RD+((RD**POW)-F*EXP(-E/TR(J))*DTH)**(1./POW))/DTH
GO TO 709
708 BF=BBB(I,K)
DROT(K)=RD*(EXP(-BF*DTH*EXP(-E/TR(J)))-1.)/DTH
709 ROCOM(J,K)=ROCOM(J,K)+DROT(K)*DTH
DMDB(J)=-DEL(J)*((DROT(1)+DROT(2))*GAM+OMGAM*DROT(3))/RR(J)
701 RON(J)=(ROCOM(J,1)+ROCOM(J,2))*GAM+OMGAM*ROCOM(J,3)
702 CONTINUE
700 CONTINUE
C NOW SPECIFY NECESSARY NEW POST-DECOMPOSITION PROPERTIES
2522 J=JFHP


MATL(NL+1)=ISV
DO 85 I=1,NL
IF(ABS(RON(I)-RHO(1))-.01) 81,81,82
81 MATL(I)=1
X(I)=1.0
GO TO 85
82 IF (ABS(RON(I)-RHO(2))-.01) 83,83,84
83 MATL(I)=2
X(I)=0.
CN(I)=CNC(I)
GO TO 85
84 MATL(I)=0
X(I)=PETE-PET/RON(I)
IF (WT) 8500,8500,8501
8501 L=WT
CALL LOOK(31+L,X(I),TX(1,L),F1(1,L),F2(1,L),0,0,Y1,D1,2)
CN(I)=Y1(1)*CN(I)+Y1(2)*CNC(I)
GO TO 85
8500 CN(I)=X(I)*CN(I)+(1.0-X(I))*CNC(I)
85 RAT(I)=DEL(I)/(CN(I)+RR(I))

```
      IF (NDBU) 7121,7121,7122
 7122 DO 710  I=1,NDBU
      LL=NFI(I)
      LU=NLA(I)
      DO 711    J=LL,LU
      IF(ABS(RON(J)-RHOV(I))-.01) 712,712,713
 712     MATL(J)= 20+2*I
         X(J)=1.0
      GO TO 716
 713  IF(ABS(RON(J)-RHOC(I))-.01) 714,714,715
 714     MATL(J)=21+2*I
      X(J)=0.
      RON(J)=RHOC(I)
      CN(J)=CNC(J)
      GO TO 716
 715     MATL(J)=0
         X(J)=P(I)-PP(I)/RON(J)
      IF(NBUFT(I)) 7151,7151,7150
 7150 L=NBUFT(I)
      CALL LOOK(91+L,X(J),TX(1,L),F1(1,L),F2(1,L),0,0,Y1,D1,2)
      CN(J)=Y1(1)*CN(J)+Y1(2)*CNC(J)
      GO TO 716
```


7151 CONTINUE
CN(J)=X(J)*CN(J)+(1.0-X(J))*CNC(J)
716 RAT(J)=DEL(J)/(CN(J)*RR(J))
711 CONTINUE
710 CONTINUE
7121 GSM= 0.0
DO 122 I=1,NL
122 GSM=GSM+DMDG(I)
GSMG=GSM
GSMT=GSMT+GSMS*ASU/AREA(1)*DTH
GSM2=0.
IF (NDBU) 7180,7180,7181
7181 DO 717 I=1,NDBU
LL=NFI(I)
LU=NLA(I)
DO 718 J=LL,LU
718 GSM2=GSM2+DMDG(J)
717 CONTINUE
7180 GSM2S=GSM2

```
         GSM2T=GSM2T+GSM2S*ASU/AREA(1)*DTH
         GS=GSMS+GSM2S
         GSM=GS
      DCDT=(CPE(1)-COLD)/DTH
      DPDT=(CPE(2)-POLD)/DTH
C
C        CALCULATION OF IMPLICIT TEMPERATURE COEFFICIENTS
C        AND INTERNAL ENERGY RATE TERMS
C     MAIN BLOCK
      DVB=0.
      SOEGR=0.
      GSEGR=0.
      TB=0.
      RAT(1)=2.*RAT(1)
      CPNL=CP(NL)
      NLM=NL-1
      IMIN=0

      DO 30 I=IMIN,NLM

      IF (I) 15,15,14

   14 GSM=GSM-DMDG(I)
      DRODTD=-DMDG(I)/(RR(I)*DEL(I))
      FACT1=DTH/(DEL(I)*RR(I))
      FACT2=GSM/(DEL(I)*RR(I))
      A(I)=-FACT1*DVB
      DVB=1.0/(0.5*(RAT(I)+RAT(I+1))+RC(I)/RR(I))
      TERM2=RON(I)*CP(I)-DTH*(CPGAS*(DRODTD-FACT2)
     1         -DSDT*RO1*CP1/DEL(I))
      TERM1=FACT1*DVB
      B(I)=TERM2-A(I)+TERM1
      C(I)=-TERM1
      D(I)=TA(I)*TERM2+(HGAG*DRODTD-HBAR*(RON(I)
     1        -RO(I))/DTH-FACT2*HGAS-DSDT*RO1*H1/DEL(I))*DTH

   15 RO1=ROT(I+1)
      X1=PETE-PET/RO1
      CP1=CPV(I+1)*X1+CPC(I+1)*(1.0-X1)
      H1=HP(I+1)*X1+HC(I+1)*(1.0-X1)
      CP(I+1)=CPV(I+1)*X(I+1)+CPC(I+1)*(1.0-X(I+1))
      TN=-RO1*HBAR+RO1*H1+T
      HBAR=PETE*HP(I+1)-PET/RHO(1)*HC(I+1)
      T=-RO1*H1+RO1*HBAR
   20 CALL LOOK (2,TA(I+1),TT1,THG,0.0,0.0,HGAS,CPGAS,1)
      HGAS=HGAS+DELHG
      GSEGR=GSEGR+HGAS*DMDG(I+1)
      SOEGR=SOEGR+HBAR*DMDG(I+1)

      IF (I) 24,24,25

   24 EGO=GSMS*HGAS
      HW=HGAS

      GO TO 30
```

```
   25 TERM3=(-FACT2*CPGAS-DSDT*RO1*CP1/DEL(I))*DTH
      C(I)=C(I)+TERM3
      D(I)=D(I)+TA(I+1)*TERM3+(FACT2*HGAS+DSDT*RO1*H1/DEL(I))*DTH
      TB=TB-TN*DSDT*RR(I)

   30 CONTINUE

      A(1)=DTH/DEL(1)
      TT=TT+TB*DTH/AREA(1)*ASU
C     NOW THE LAST ABLATING NODE REQUIRES DIFFERENT TREATMENT
      DROOTD=-DMDG(NL)/(RR(NL)*DEL(NL))
      FACT1=DTH/(DEL(NL)*RR(NL))
      A(NL)=-FACT1*DVB
      DVB=1.0/(0.5*(RAT(NL)+RAT(NBM))+RC(NL)/RR(NL))
      C(NL)=-FACT1*DVB
      TERM2=RON(NL)*CP(NL)-(CPGAS*DROOTD+(DSDT/DEL(NL))*
     1         (RO (NL)*CPNL   -RO1*CP1))*DTH
      B(NL)=TERM2-C(NL)-A(NL)
      D(NL)=TA(NL)*TERM2+DTH*(HGAS*DROOTD-HBAR*(RON(NL)-
     1         RO(NL))/DTH+DSDT*(RO (NL)*H(NL)-RO1*H1)/DEL(NL))
      K = NL
      GSM=GSM-DMDG(NL)

      IF(NDBU) 7170.7171.7170

 7170 FACT2=GSM/(DEL(NL)*RR(NL))
      TERM2=FACT2*CPGAS*DTH
      B(NL)=B(NL)+TERM2
      D(NL)=D(NL)+TA(NL)*TERM2-FACT2*HGAS*DTH
      CALL LOOK(2,TA(NBM),TT1,THG,0,0,0,HGAS,CPGAS,1)
      HGAS=HGAS+DELHG
      C(NL)=C(NL)-FACT2*CPGAS*DTH
      D(NL)=D(NL)-TA(NBM)*FACT2*CPGAS*DTH+FACT2*HGAS*DTH

 7171 CONTINUE
C-----NOW FOR DECOMPOSING BACK-UPS IF ANY

      IF (NDBU) 7250,7250,7251

 7251 DO 720  L=1,NDBU

      LL=NFI(L)-1
      LU=NLA(L)

      DO 7241  I=LL,LU
```

```
      IF(I-NFI(L)+1) 725.726.725

725     GSM=GSM-DMDG(I)
      DVBS=DVB
        K=K+1
        DRODTD=-DMDG(I)/(RR(I)*DEL(I))
        FACT1=DTH/(DEL(I)*RR(I))
        FACT2=GSM/(DEL(I)*RR(I))
        A(K)=-FACT1*DVB
        DVB=1.0/(0.5*(RAT(I)+RAT(I+1))+RC(I)/RR(I))
        TERM2=RON(I)*CP(I)-DTH*(CPGAS*(DRODTD-FACT2))
        TERM1=FACT1*DVB
        B(K)=TERM2-A(K)+TERM1
        C(K)=-TERM1
        D(K)=TA(I)*TERM2+(HGAS*DRODTD-HBAR*(RON(I)-RO(I))/DTH
     C  -FACT2*HGAS)*DTH

      IF(I-NLA(NDBU)) 726.727.727

726     CP(I+1)=CPV(I+1)*X(I+1)+CPC(I+1)*(1.0-X(I+1))
      HBARS=HBAR
        HBAR=P(L)*HP(I+1)-PP(L)/RHOV(L)*HC(I+1)
      CALL LOOK (2.TA(I+1). TT1.THG.0.0.0.HGAS.CPGAS.1)
        HGAS=HGAS+DELHG

      IF(I-NFI(L)+1) 724.724.727

727     TERM3= (-FACT2*CPGAS)*DTH
        C(K)=C(K)+TERM3
        D(K)=D(K)+TA(I+1)*TERM3+FACT2*HGAS*DTH

724 CALL SSWTCH(5.KKSW)

      GO TO (7240.7241).KKSW

7240 WRITE(KOUT.7270) I.K.L.DEL(I).RR(I).CP(I).CPV(I).CPC(I).HP(I).
    1HC(I).CN(I).RAT(I).RO(I).RON(I).X(I).DMDG(I).DRODTD.P(L).PP(L).
    2HGAS.CPGAS.DVB.DVBS.HBAR.HBARS.GSM.FACT1.FACT2.TERM1.TERM2.TERM3.
    3GA(L).OMGA(L).A(K).B(K).C(K).D(K)
7270 FORMAT(5X.3I5.10E10.3/(20X.10E10.3))

7241 CONTINUE

720 CONTINUE
```

```
C     NOW FOR BACK UPS IF ANY
7250 IF(NUMN-NBM2) 60,40,40
  40 DO 50 I=NBM2,NUMN
      K=K+1
      FACT1=DTH/(DEL(I)*RR(I))
      A(K) = -FACT1*DVB
      DVB=1.0/(0.5*(RAT(I)+RAT(I+1))+RC(I)/RR(I))
      C(K)=-FACT1*DVB
      B(K)=RO(I)*CP(I)-C(K)-A(K)
  50 D(K)=TA(I)*RO(I)*CP(I)
C     NOW IF THE LAST NODE WAS INSULATED WE MUST REPAIR LAST B AND C
  60 IF(HRES) 80,70,80
  70 B(K)=B(K)+C(K)
      C(K)=0.
C     NOW BEFORE GAUSS REDUCTION REWRITE LAST LINE OF MATRIX
  80 D(K)=D(K)-C(K)*TRES
      L=K
      DO 90 I=2,K
      L=L-1
      D(L)=D(L)-C(L)/B(L+1)*D(L+1)
  90 B(L)=B(L)-C(L)/B(L+1)*A(L+1)
      B(1)=B(1)/A(1)
      D(1)=D(1)/A(1)
      PGPU=EGO-GSEGR
      PGPUT=PGPUT+PGPU*DTH/AREA(1)*ASU
      DECOM=GSEGR-SOEGR
```

```
      DECOMT=DECOMT+DECOM*DTH/AREA(1)*ASU
C
C     SURFACE BOUNDARY CONDITION PACKAGE
C
      CHZ=CH
      XP1=X(1)
      ITL=10
      ITS=1
      SNET=(1.+SWELL)*SA-SWELL*CPE(1)

      IF(II-2) 2502.1420.2501

 1420 DSDTB=QRA/12000.0
      TA(1)=HE
      HE=0.
      HW=0.0
      BR=0.0
      CHD=DSDTB*((ROA(1)+ROB(1))*GAMA+ROC(1)*OMB)
      RAD=0.
      QRA=0.
      QCHEM=0.
      QCONV=0.

      GO TO 1437

 2501 TABC=30008.0
      DSDTB=0.
      ERFX=D(1)
      QCHEM=0.
      QCONV=0.

      GO TO 2503

 2502 IF (NR) 1424.1424.1425

 1425 CH=CH/((1+SNET/ABS(RSV))**REX)
      CHZ=CH

 1424 GO TO (1427.1428).NFIS

 1427 BF=(CHD-CHFL+BGHS)/CH

      GO TO 1429
```

```
1420 BF=(CMD-CMFL)/CH

1429 CONTINUE
     PHI=2.*BRP*BF

     IF(PHI-.01)1422,1422,1423

1422 CH=CH*(1.-.5*PHI)

     GO TO 1426

1423 CH=CH/(EXP(PHI)-1.)*PHI

1426 GO TO (14260.14261).NFIS

14260 CH=AMAX1(CH.GS/AMAX1(TMG(1).TMG(NMG)))

14261 CONTINUE
      ERFX=CH*HE+D(1)
      CALL LOOK (12.GS  /(CH*CMH).TMG.0.0.0.0.Y2.D2.0)
      IMG=IR(12)
      VRM=VR
      IPR=1

     IF(NPR-1) 2510.2510.2511

2511 CALL LOOK(13.PRES.TPR.0.0.0.0.Y2.D2.0)
     IPR=IR(13)
     ILO(16)=NLO(IMG.IPR+1)
     IHI(16)=NHI(IMG.IPR+1)
     ILO(17)=NLO(IMG+1.IPR+1)
     IHI(17)=NHI(IMG+1.IPR+1)
     VRP=VR
     I3=ILO(16)
     I4=ILO(17)

2510 ILO(14)=NLO(IMG.IPR)
     IHI(14)=NHI(IMG.IPR)
     ILO(15)=NLO(IMG+1.IPR)
     IHI(15)=NHI(IMG+1.IPR)
     I1=ILO(14)
```

```
      I2=ILO(15)
      IF(NPR-1) 2512.2512.2513
2513  IF(IHI(17)-I4) 420.420.2514
2514  IF(IHI(16)-I3) 420.420.2512
2512  IF(IHI(14)-I1) 420.420.2504
2504  IF(IHI(15)-I2) 420.420.2505
2505  TABC=TTS(I1.IMG.IPR)+VRM*(TTS(I2.IMG+1.IPR)-TTS(I1.IMG.IPR))
      IF(NPR-1) 2503.2503.2515
2515  TABC=TABC+VRP*(TTS(I3.IMG.IPR+1)+VR*(TTS(I4.IMG+1.IPR+1)-TTS(I3.IM
     1G.IPR+1))-TABC)
2503  IF(TSAVE-TABC) 420.420.421
C     ---------    ABLATING SURFACE
421   IF(IAB) 422.422.423
422   CMDL=TLMC(I1.IMG.IPR)-VR*(TLMC(I1.IMG.IPR)-TLMC(I2.IMG+1.IPR))
      CMD=EXP(CMDL)*CH
      IAB=1
423   CALL LOOK(14.CMDL.TLMC(1.IMG.IPR).TTS(1.IMG.IPR).TCHEM(1.IMG.IPR).
     1TBPF(1.IMG.IPR).0.Y2(1).Y2(4).3)
```

```
      IRA=IR(14)
      CALL LOOK(16.CMDL.TLMC(1.IMG+1.IPR).TTS(1.IMG+1.IPR).TCHEM(1.IMG+1
     1.IPR).TBPF(1.IMG+1.IPR).0.Y2(7).Y2(10).3)
      IRB=IR(15)

      IF(NPR-1) 4233.4233.4231

 4231 CALL LOOK(16.CMDL.TLMC(1.IMG.IPR+1).TTS(1.IMG.IPR+1).TCHEM(1.IMG.I
     1PR+1).TBPF(1.IMG.IPR+1).0.Y2(13).Y2(16).3)
      IRC=IR(16)
      CALL LOOK(17.CMDL.TLMC(1.IMG+1.IPR+1).TTS(1.IMG+1.IPR+1).TCHEM(1.I
     1MG+1.IPR+1).TBPF(1.IMG+1.IPR+1).0.Y2(19).Y2(22).3)
      IRD=IR(17)

      DO 4232 I=1.12

 4232 Y2(I)=Y2(I)+VRP*(Y2(I+12)-Y2(I))

      IF(NBPF) 4237.4237.4230

 4230 IF(VRP-1.) 4234.4234.4235

 4235 Y2(3)=Y2(15)
      Y2(9)=Y2(21)

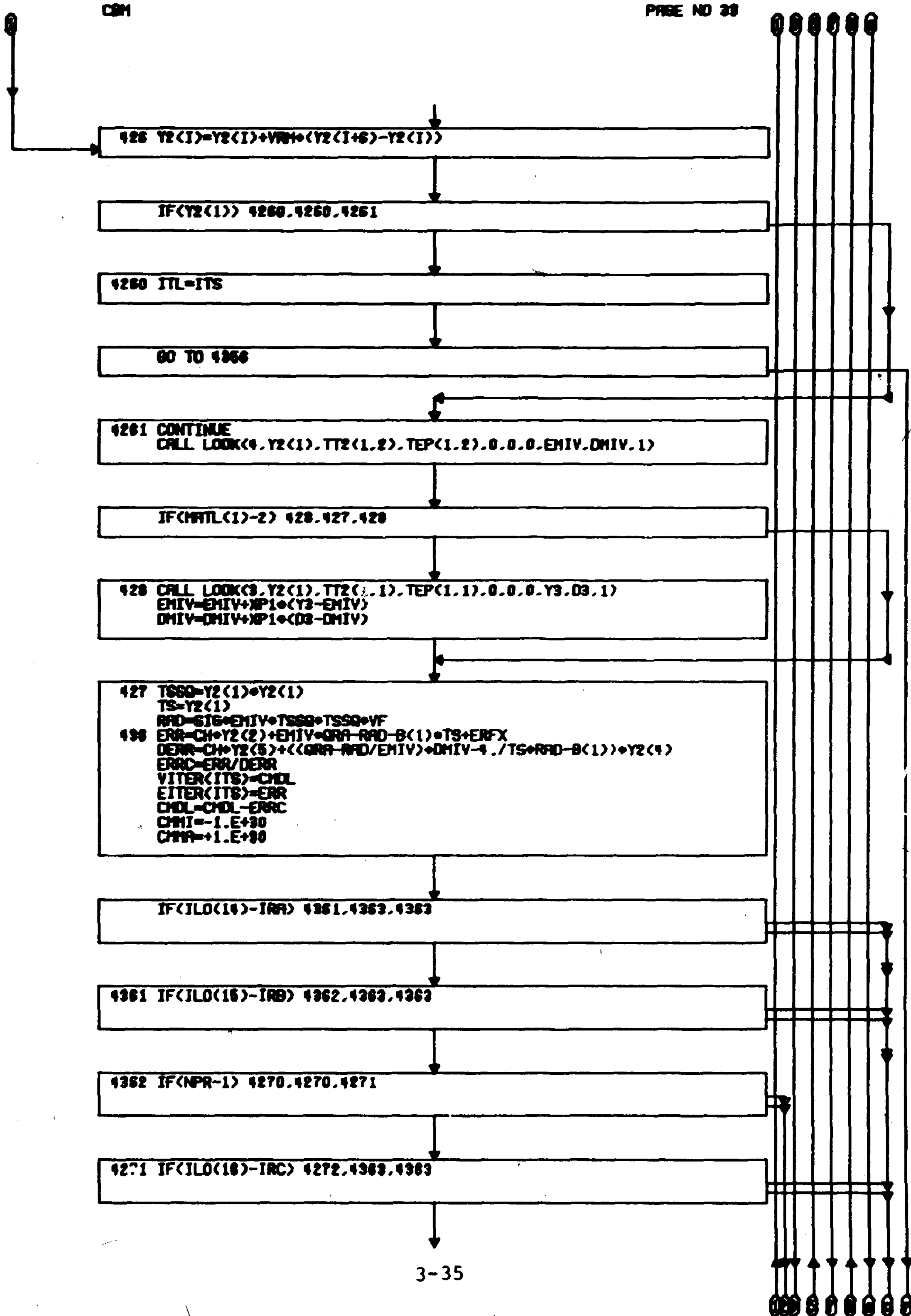
      GO TO 4237

 4234 IF(VRP) 4236.4237.4237

 4236 Y2(3)=(Y2(3)-Y2(15)*VRP)/(1.-VRP)
      Y2(9)=(Y2(9)-Y2(21)*VRP)/(1.-VRP)

 4237 CONTINUE

 4233 DO 426 I=1.6
```


426 Y2(I)=Y2(I)+VRM*(Y2(I+6)-Y2(I))
IF(Y2(1)) 4260,4260,4261
4260 ITL=ITS
GO TO 4366
4261 CONTINUE
CALL LOOK(4,Y2(1),TT2(1,2),TEP(1,2),0,0,0,EMIV,DMIV,1)
IF(MATL(1)-2) 428,427,428
428 CALL LOOK(3,Y2(1),TT2(1,1),TEP(1,1),0,0,0,Y3,D3,1)
EMIV=EMIV+XP1*(Y3-EMIV)
DMIV=DMIV+XP1*(D3-DMIV)
427 TSSQ=Y2(1)*Y2(1)
TS=Y2(1)
RAD=SIG*EMIV*TSSQ*TSSQ*VF
436 ERR=CH*Y2(2)+EMIV*QRA-RAD-B(1)*TS+ERFX
DERR=CH*Y2(5)+((QRA-RAD/EMIV)*DMIV-4./TS*RAD-B(1))*Y2(4)
ERRC=ERR/DERR
VITER(ITS)=CMDL
EITER(ITS)=ERR
CMDL=CMDL-ERRC
CMMI=-1.E+30
CMMA=+1.E+30
IF(ILO(14)-IRA) 4361,4363,4363
4361 IF(ILO(15)-IRB) 4362,4363,4363
4362 IF(NPR-1) 4270,4270,4271
4271 IF(ILO(16)-IRC) 4272,4363,4363

```
4272 IF(ILD(17)-IRD) 4273,4363,4363

4273 CMMI=AMAX1(TLMC(IRD,IMG+1,IPR+1)+TLMC(IRD-1,IMG+1,IPR+1),TLMC(IRC,
    1IMG,IPR+1)+TLMC(IRC-1,IMG,IPR+1))

4270 CMMI=AMAX1(CMMI,TLMC(IRA,IMG,IPR)+TLMC(IRA-1,IMG,IPR),TLMC(IRB,IMG
    1+1,IPR)+TLMC(IRB-1,IMG+1,IPR))/2.
     CMDL=AMAX1(CMDL,CMMI)

4363 IF(IHI(14)-IRA-1) 4366,4366,4364

4364 IF(IHI(15)-IRB-1) 4366,4366,4274

4274 IF(NPR-1) 4275,4275,4276

4276 IF(IHI(16)-IRC-1) 4366,4366,4277

4277 IF(IHI(17)-IRD-1) 4366,4366,4278

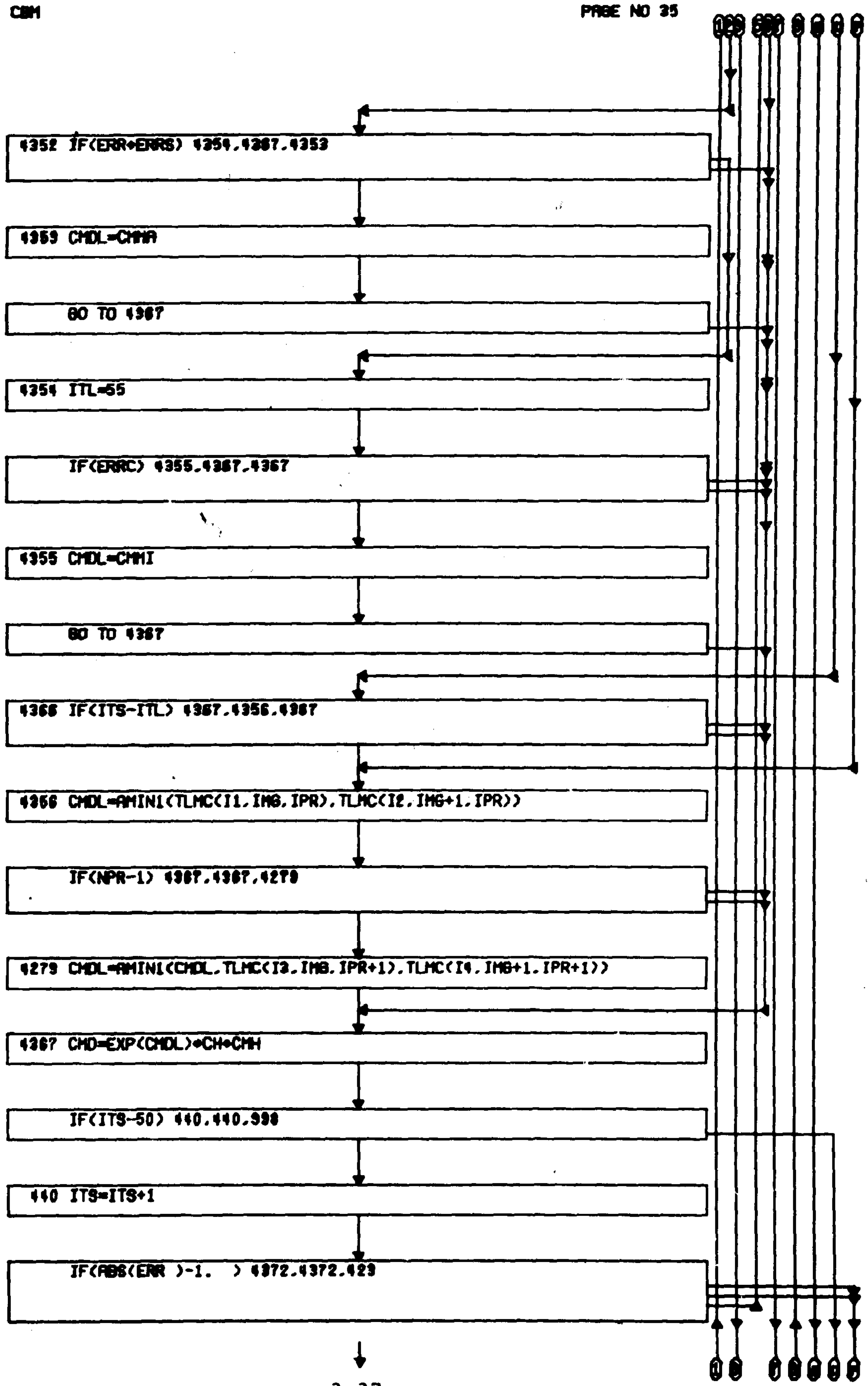
4278 CMMA=AMIN1(TLMC(IRD+1,IMG+1,IPR+1)+TLMC(IRD+2,IMG+1,IPR+1),
    1TLMC(IRC+2,IMG,IPR+1))

4275 CMMA=AMIN1(CMMA,TLMC(IRA+1,IMG,IPR)+TLMC(IRA+2,IMG,IPR),TLMC(IRB+1
    1,IMG+1,IPR)+TLMC(IRB+2,IMG+1,IPR))/2.
     CMDL=AMIN1(CMDL,CMMA)

     IF(ITS-ITL-1) 4966,4951,4952

4351 ERRS=ERR
     CMDL=CMMA

     GO TO 4367
```


4352 IF(ERR+ERRS) 4354,4367,4353
4353 CMDL=CMMA
GO TO 4367
4354 ITL=55
IF(ERRC) 4355,4367,4367
4355 CMDL=CMMI
GO TO 4367
4366 IF(ITS-ITL) 4367,4356,4367
4356 CMDL=AMIN1(TLMC(I1,IMG,IPR),TLMC(I2,IMG+1,IPR))
IF(NPR-1) 4367,4367,4279
4279 CMDL=AMIN1(CMDL,TLMC(I3,IMG,IPR+1),TLMC(I4,IMG+1,IPR+1))
4367 CMD=EXP(CMDL)*CH*CMH
IF(ITS-50) 440,440,398
440 ITS=ITS+1
IF(ABS(ERR)-1.) 4372,4372,429

```
C     ---------  NON-ABLATING SURFACE

420  TS=TSAVE
     IAB=0
     CMD=0.0

430  IF(II-3) 4302.433.4302

4302 ILO(18)=1
     IHI(18)=KHI(IMG.IPR)
     ILO(19)=1
     IHI(19)=KHI(IMG+1.IPR)
     CALL LOOK (18.TS.TTS(1.IMG.IPR).TCHEM(1.IMG.IPR).0.0.0.Y2(1).Y2(2)
    1.1)
     CALL LOOK (19.TS.TTS(1.IMG+1.IPR).TCHEM(1.IMG+1.IPR).0.0.0.Y2(3).
    1Y2(4).1)

     IF(NPR-1) 4322.4322.4303

4303 ILO(20)=1
     IHI(20)=KHI(IMG.IPR+1)
     ILO(21)=1
     IHI(21)=KHI(IMG+1.IPR+1)
     CALL LOOK (20.TS.TTS(1.IMG.IPR+1).TCHEM(1.IMG.IPR+1).0.0.0.Y2(5).
    1Y2(6).1)
     CALL LOOK (21.TS.TTS(1.IMG+1.IPR+1).TCHEM(1.IMG+1.IPR+1).0.0.0.
    1Y2(7).Y2(8).1)

     DO 4321 I=1.4

4321 Y2(I)=Y2(I)+VRP*(Y2(I+4)-Y2(I))

4322 DO 4323 I=1.2

4323 Y2(I)=Y2(I)+VRM*(Y2(I+2)-Y2(I))

433  CALL LOOK (4.TS.TT2(1.2).TEP(1.2).0.0.0.EMIV.DMIV.1)

     IF(MATL(1)-2) 434.442.434
```

```
434  CALL LOOK (3.TS.TT2(1.1).TEP(1.1).0.0.0.Y3.D3.1)
     EMIV=EMIV+XP1*(Y3-EMIV)
     DMIV=DMIV+XP1*(D3-DMIV)

442  TSSQ=TS*TS

     IF(II-3) 4422.4421.4422

4421 IF (EMIV) 4422.4423.4422

4423 EMIV=1.0

4422 RAD=SIG*EMIV*TSSQ*TSSQ*VF
 439 ERR=CH*Y2(1)+EMIV*QRA-RAD-B(1)*TS+ERFX
     DERR=CH*Y2(2)+((QRA-RAD/EMIV)*DMIV-4./TS*RAD-B(1))
     ERRC=ERR/DERR
     VITER(ITS)=TS
     EITER(ITS)=ERR
     TS=TS-ERRC

     IF(II-3) 4391.4507.4507

4391 TSMI=-1.E+30
     TSMA=+1.E+30
     IRA=IR(18)
     IRB=IR(19)
     IRC=IR(20)
     IRD=IR(21)

     IF(ILO(18)-IRA) 4500.4501.4501

4500 IF(ILO(19)-IRB) 4502.4501.4501

4502 IF(NPR-1) 4503.4503.4504
```

```
4504 IF(ILO(20)-IRC) 4505,4501,4501

4505 IF(ILO(21)-IRD) 4506,4501,4501

4506 TSMI=AMAX1(TTS(IRD,IMB+1,IPR+1)+TTS(IRD-1,IMB+1,IPR+1),TTS(IRC,
    1IMB,IPR+1)+TTS(IRC-1,IMB,IPR+1))

4503 TSMI=AMAX1(TSMI,TTS(IRB,IMB+1,IPR)+TTS(IRB-1,IMB+1,IPR),
    1TTS(IRA,IMB,IPR)+TTS(IRA-1,IMB,IPR))/2.
     TS=AMAX1(TS,TSMI)

4501 IF(IHI(18)-IRA-1) 4507,4507,4508

4508 IF(IHI(19)-IRB-1) 4507,4507,4509

4509 IF(NPR-1) 4510,4510,4511

4511 IF(IHI(20)-IRC-1) 4507,4507,4512

4512 IF(IHI(21)-IRD-1) 4507,4507,4513

4513 TSMA=AMIN1(TTS(IRD+1,IMB+1,IPR+1)+TTS(IRD+2,IMB+1,IPR+1),
    1TTS(IRC+1,IMB,IPR+1)+TTS(IRC+2,IMB,IPR+1))

4510 TSMA=AMIN1(TSMA,TTS(IRB+1,IMB+1,IPR)+TTS(IRB+2,IMB+1,IPR),
    1TTS(IRA+1,IMB,IPR)+TTS(IRA+2,IMB,IPR))/2.
     TS=AMIN1(TS,TSMA)

4507 CONTINUE

     IF(ITS-60) 441,441,999
```

```
441 ITS=ITS+1

     IF(ABS(ERR )-1.  ) 4390,4390,430

998 WRITE (KOUT,529)
     WRITE(KOUT,502)(VITER(I),EITER(I),I=1,51)
     WRITE(KOUT,502) TH,DTH,VRM,ERFX,TABC,EMIV,DMIV,RAD,B(1),CH,PHI,
    1 D(1),HE,XP1,QRA,Y2(1),Y2(2),Y2(3),Y2(4)
     TH=THFIN

     GO TO 3000

C    ---------- POST ITERATION

4390 IF(II-2) 4371,4371,1437

4371 Y2(2)=Y2(1)

4372 QCHEM=Y2(2)

     IF(ISEN(1))4373,4374,4373

4374 QCONV=0.

     GO TO 1439

4373 CALL DBLE(1,TS,QCONV,ISEN(IPR),TTSEN(1,IPR),THSEN(1,IPR),TCPSEN(1,
    1IPR))

     IF(NPR-1) 1439,1439,1438

1438 CALL DBLE(1,TS,QQ    ,ISEN(IPR+1),TTSEN(1,IPR+1),THSEN(1,IPR+1),TCP
    1SEN(1,IPR+1))
```

```
      QCONV=QCONV+VRP*(QQ-QCONV)

 1435 QCHEM=(QCHEM+QCONV)*CH
      HW=QCONV
      QCONV=CH*(HE-QCONV)
      DSDTB=CMD/RHO(2)

      IF(NBPF) 1437,1437,4375

 4375 IF(IAB) 1437,1437,4376

 4376 CMFL=EXP(Y2(3))*CH*CMH

 1437 RO(1)=RON(1)
      BR=CH/CHZ
      QRP=EMIV*QRA
      QCOND=-D(1)+B(1)*TA(1)
      QCONVT=QCONVT+QCONV*DTH/AREA(1)*ASU
      QCHEMT=QCHEMT+QCHEM*DTH/AREA(1)*ASU
      QCONDT=QCONDT+QCOND*DTH/AREA(1)*ASU
      QRPT=QRPT+QRP*DTH/AREA(1)*ASU
      RADT=RADT+RAD*DTH/AREA(1)*ASU
      DEDT=RON(1)*CP(1)*(TS-TSAVE)*DEL(1)/DTH

      DO 95 I=2,NL

      RO(I) = RON(I)
      TEMP =(D(I   )-A(I   )*TA(I-1))/B(I   )
      DEDT=DEDT+RON(I)*CP(I)*(TEMP-TA(I))*DEL(I)*RR(I)/DTH

   95 TA(I)=TEMP

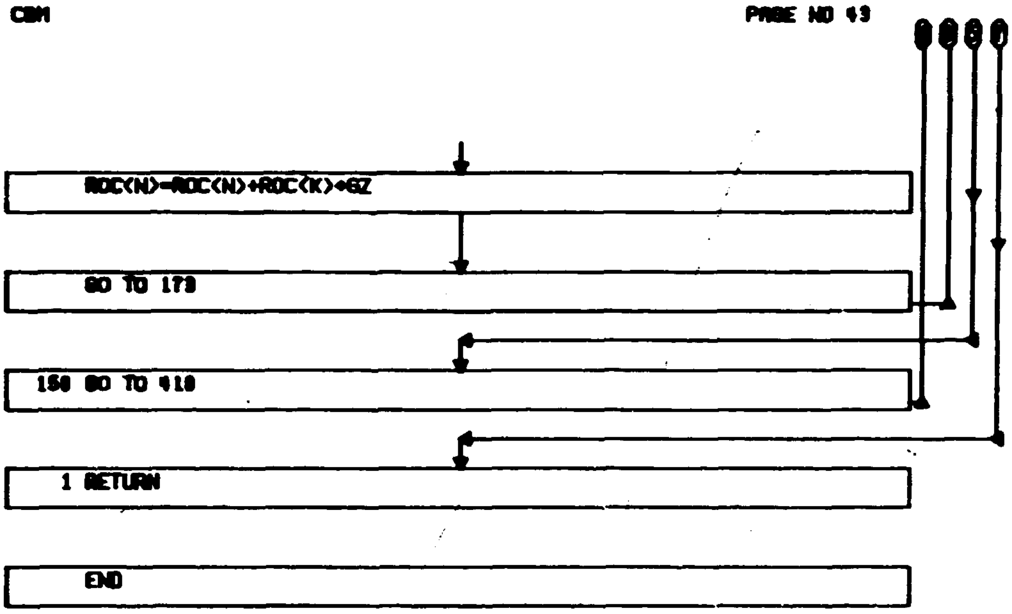
      IF (NUMN-NBM) 97,96,96

   96 K=NL
      TA(NBM-1) = TA(NL)

      DO 98 I = NBM,NUMN
```

```
      K = K+1
   98 TA(I) = (D(K)-A(K)*TA(I-1))/B(K)
   97 DEDTT=DEDTT+DEDT+DTH/AREA(1)*ASU
      IF(NDBU) 755,756,755
  755 LL=NFI(1)
      LU=NLA(NDBU)
      DO 757 I=LL,LU
  757 RO(I)=RON(I)
  756 CONTINUE
C
C
C     SHRINK (AND DROP) OF LAST ABLATING NODE
C
C     DEL(NL)=DEL(NL)-DS (SEE INT DECOMP)
      IF(DEL(NL)-DELM)149,149,150
  149 DRLP=DEL(NL)*RO(NL)*RR(NL)
      DRLCP=DRLP*CP(NL)
      NL=NL-1
      RC(NL)=RC(NL+1)
      DRL=DEL(NL)*RO(NL)*RR(NL)
      DRLC=DRL*CP(NL)
      HAPHB=DRL*H(NL)+DRLP*H(NL+1)
      TOP1=DRL+DRLP
      TOP2=DRLC+DRLCP
      TOP3=DRLC*TA(NL)  +DRLCP*TA(NL+1)
      VOL=DEL(NL)*RR(NL)+DEL(NL+1)*RR(NL+1)
      DEL(NL)=DEL(NL)+DEL(NL+1)
      RA(NL)=RA(NL)+6.*DEL(NL+1)
      RO(NL)=TOP1/VOL
      CP(NL)=TOP2/TOP1
      TA(NL)=TOP3/TOP2
      H(NL)=HAPHB/TOP1
      DELR=DEL(NL+1)*RR(NL+1)/VOL
      CZ=1.0-DELR
      DZ=0.0
      BZ=CZ
      NZ=JF+NL-JFH
      N=NZ-JF+1
      K=N
```

```
      FZ=DELR
      EZ=GZ
      GO TO 178
172   DZ=DZ+1.0
173   FZ=DZ-CZ
      IF(K-NZ) 175.174.175
174   GZ=DELR
175   K=K+1
      CZ=CZ+GZ
176   EZ=CZ-DZ
      IF(EZ)178.177.177
177   ROA(N)=ROA(N)+FZ*ROA(K)
      ROB(N)=ROB(N)+FZ*ROB(K)
      ROC(N)=ROC(N)+FZ*ROC(K)
      IF(N-NZ) 171.150.171
171   N=N+1
179   ROA(N)=ROA(K)*EZ
      ROB(N)=ROB(K)*EZ
      ROC(N)=ROC(K)*EZ
      GO TO 172
178   ROA(N)=ROA(N)+ROA(K)*GZ
      ROB(N)=ROB(N)+ROB(K)*GZ
```


ROC(N)=ROC(N)+ROC(K)*GZ
GO TO 170
150 GO TO 410
1 RETURN
END

```
      SUBROUTINE INPOUT
C     *****    SEE INPOUT LISTING FOR  COMMON       STATEMENTS    *****
C     *****                            DIMENSION    STATEMENTS    *****
C     *****                            EQUIVALENCE  STATEMENTS    *****
C     *****                            FORMAT       STATEMENTS    *****
C     *****                            DATA         STATEMENTS    *****
      INPUT=5
      KOUT=6
      INCH=5
      WT=0.0

      DO 3500 I=1.5

 3500 NBUFT(I)=0

C     INPUT/OUTPUT
C
    1 NPG=1
      WRITE (KOUT.551)NPG

      READ  (INPUT. 499. END=999)  (RECORD(I). I=1.36)

      GO TO 998

  999 CONTINUE

      STOP

  998 CONTINUE
      WRITE (KOUT.502)(RECORD(I).I=1.36)
      WRITE (KOUT.503)
      WRITE (KOUT.504)
      WRITE (KOUT.505)
      WRITE (KOUT.506)
      READ (INPUT.564) A9.RHOOA.RHORA.BA.PSIA.EA.TRACA.B9.RHOOB .RHORB.B
     1B.PSIB.EB.TRACB  .C9.RHOOC.RHORC.BC.  PSIC.EC.TRACC.NDBU
      WRITE (KOUT.507)A9.RHOOA.RHORA.BA.PSIA.EA.TRACA.B9.RHOOB.RHORB.BB.
     1PSIB.EB.TRACB  .C9.RHOOC.RHORC.BC.  PSIC.EC.TRACC
      READ (INPUT.583) JF.NUMN.NN.NO.NI.THZRO.THFIN.DTPRT.DTPR2.DTPR3.
     1DTHB.BRP.TPR2.TPR3.DELM.DH1.DH2.DELHB.GAMA.TZ

      IF(JF-1) 171.170.172

  170 JF=2
```

```
      GO TO 172
171   JF=10
172   JFH=JF/2
      JF=JFH+JFH
      JFHP=JFH+1
      FJFS=JF
      FJFH=FJFS/2.0
      NOI=NO+NI
      IF (NO) 181,181,182
182   READ  (INPUT,580)(SO(I),I=1,NO)
181   CONTINUE
      IF (NI) 184,184,183
183   NOP=NO+1
      READ (INPUT,580) (SO(I), I=NOP,NOI)
184   IF(GAMA) 408,409,409
408   GAMA=RHOOC/(RHOOC-(RHOOA+RHOOB)-(RHOOA+RHOOB)/GAMA)
409   OMG=1.0-GAMA
      RHO(1)=GAMA*(RHOOA+RHOOB)+OMG*RHOOC
      RHO(2)=GAMA*(RHORA+RHORB)+OMG*RHORC
       GAMAM=GAMA/RHO(1)*(RHOOA+RHOOB)
      WRITE (KOUT,510)GAMA,GAMAM
      IF(NDBU) 700,701,700
700   WRITE(KOUT,7900)
7900  FORMAT (/23X,34H---DECOMPOSING BACK-UP KINETICS---/)
```

```
      DO 704 I=1.NDBU

      READ(INPUT.5640)A9.RHOO(I.1).RHOR(I.1).BBB(I.1).PSI(I.1).EE(I.1).
     1TRAC(I.1),B9.RHOO(I.2),RHOR(I.2),BBB(I.2),           PSI(I.2).EE(I.2
     2).TRAC(I.2).C9.RHOO(I.3).RHOR(I.3).BBB(I.3).PSI(I.3).EE(I.3).TRAC(
     3I.3)
      READ(INPUT.7901) DHV(I).DHC(I).GA(I).TREF(I)
      WRITE(KOUT.7902) I
 7902 FORMAT (/20X.24HDECOMPOSING BACK-UP NO. .I1)
      WRITE(KOUT.506)
      WRITE(KOUT,507) A9,RHOO(I,1),RHOR(I,1),BBB(I,1),PSI(I,1),EE(I,1),
     1TRAC(I,1).B9.RHOO(I.2).RHOR(I.2).BBB(I.2).           PSI(I.2).EE(I.2
     2),TRAC(I,2),C9,RHOO(I.3),RHOR(I,3),BBB(I.3),PSI(I,3),EE(I,3),TRAC(
     3I.3)

      IF(GA(I)) 702.703,703

  702 GA(I)=RHOO(I,3)/(RHOO(I,3)- (RHOO(I,1)+RHOO(I,2))-(RHOO(I,1)+
     1RHOO(I,2))/GA(I))

  703 OMGA(I)=1.-GA(I)
      RHOV(I)=GA(I)*(RHOO(I.1)+RHOO(I,2))+OMGA(I)*RHOO(I,3)
      RHOC(I)=GA(I)*(RHOR(I.1)+RHOR(I.2))+OMGA(I)*RHOR(I.3)
      GAMAM=GA(I)/RHOV(I)*(RHOO(I.1)+RHOO(I,2))
      WRITE(KOUT.510) GA(I).GAMAM
      P(I)=RHOV(I)/(RHOV(I)-RHOC(I))
      PP(I)=P(I)*RHOC(I)

      DO 7030 J=1.3

 7030 FF(I.J)=(1.-PSI(I.J))*BBB(I.J)*(RHOO(I.J)**(1.-PSI(I.J)))

  704 CONTINUE

  701 CONTINUE

      IF(DTHB) 412.410.412

  410 DTHB=5.

  412 DTHIN=.01
```

```
413 IF(TPR2)414,414,415

414 TPR2=THFIN

415 IF(TPR3)416,416,417

416 TPR3=THFIN

    IF(TPR2-THZRO) 418,418,417

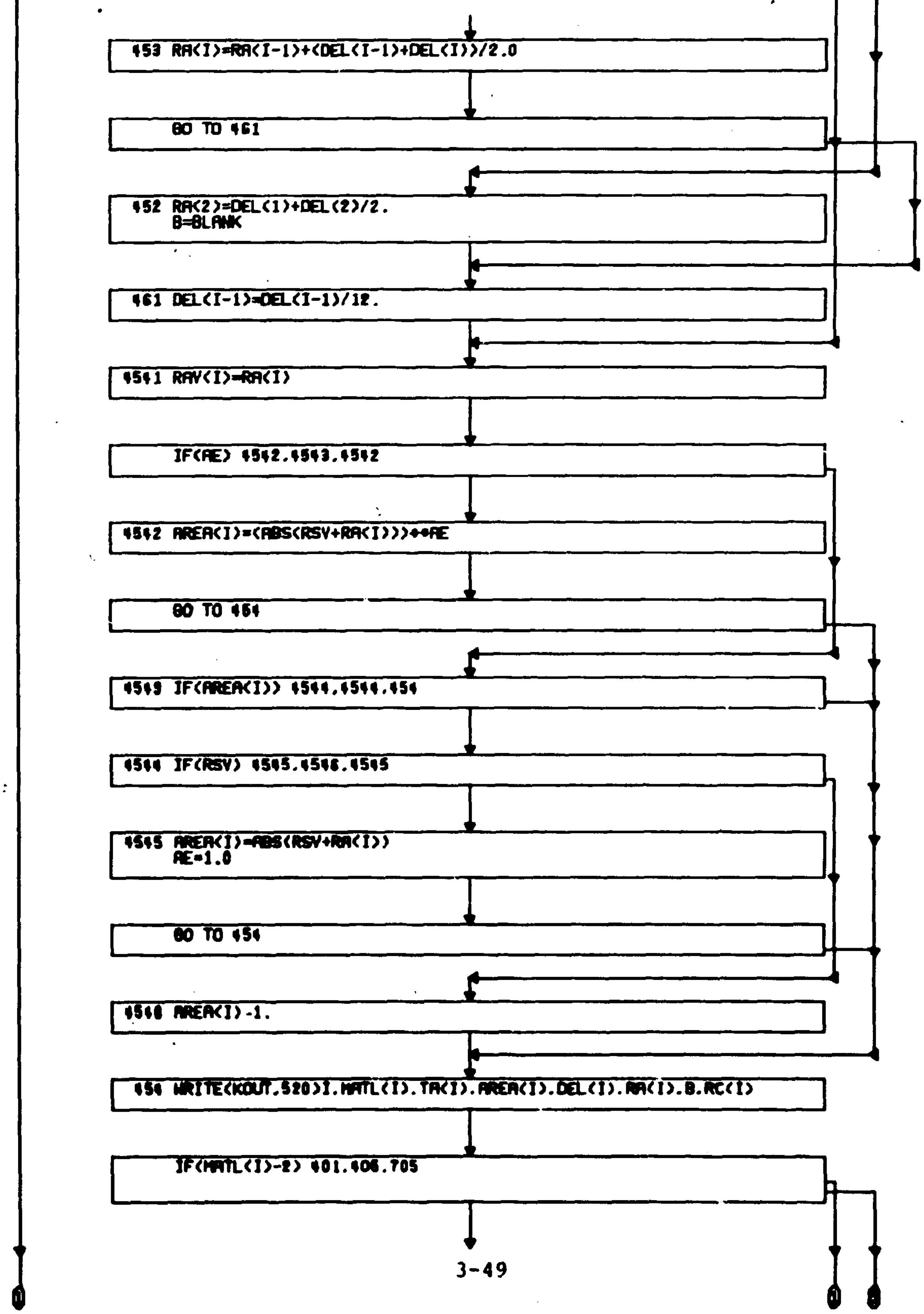
418 DTPRT=DTPR2
    DTPR2=DTPR3
    TPR2=TPR3

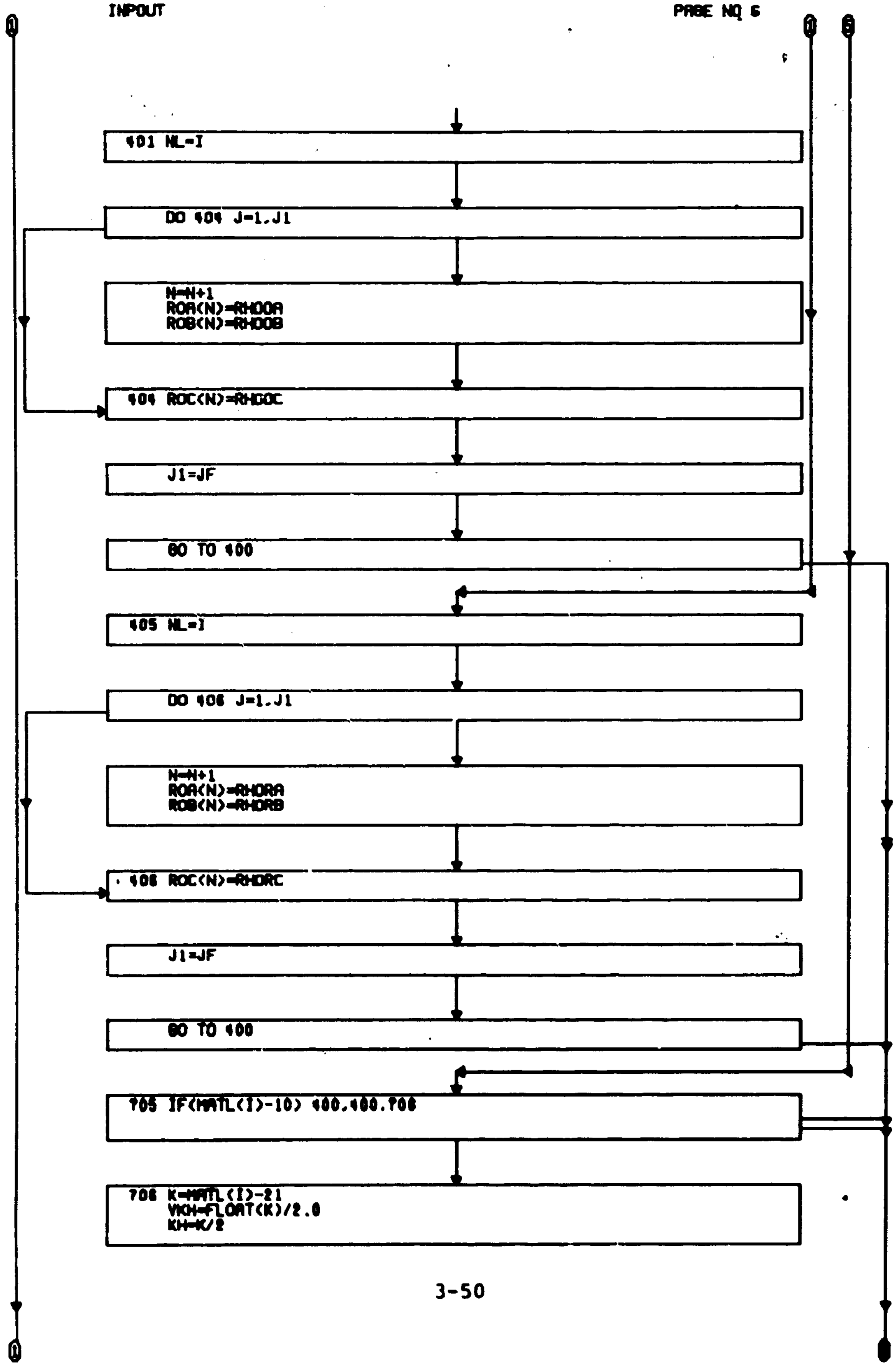
    GO TO 416

417 WRITE (KOUT,511)
    THFIN=AMAX1(THFIN,TPR2,TPR3)
    WRITE (KOUT,512)THZRO,THFIN
    WRITE (KOUT,513)DTPRT,TPR2
    WRITE (KOUT,514)DTPR2,TPR2,TPR3
    WRITE (KOUT,515)DTPR3,TPR3
    WRITE (KOUT,516) DTHB
    TRACM=AMIN1(TRACA,TRACB,TRACC)
    PETE=RHO(1)/(RHO(1)-RHO(2))
    PET=PETE*RHO(2)
C   ---------- NODAL PROPERTIES
    N=0
    KHS=10
    NDBUCH=0
    J1=JFH
    CALL LCOUNT (-NUMN-8,LCT,NPG,RECORD(3F))
302 WRITE (KOUT,517)
    WRITE (KOUT,518)
    WRITE (KOUT,519)
    B=ASTER
    READ(INPUT,560)(MATL(I),TA(I),AREA(I),DEL(I),RA(I),RC(I),I=1,NUMN)
    AE=RA(2)
    RSV=RA(1)
    RA(1)=0.0

    DO 400 I=1,NUMN

    IF(I-2) 4541,452,453
```


453 RA(I)=RA(I-1)+(DEL(I-1)+DEL(I))/2.0
GO TO 461
452 RA(2)=DEL(1)+DEL(2)/2.
B=BLANK
461 DEL(I-1)=DEL(I-1)/12.
4541 RAV(I)=RA(I)
IF(AE) 4542,4543,4542
4542 AREA(I)=(ABS(RSV+RA(I)))**AE
GO TO 454
4543 IF(AREA(I)) 4544,4544,454
4544 IF(RSV) 4545,4546,4545
4545 AREA(I)=ABS(RSV+RA(I))
AE=1.0
GO TO 454
4546 AREA(I)-1.
454 WRITE(KOUT,520)I,MATL(I),TA(I),AREA(I),DEL(I),RA(I),B,RC(I)
IF(MATL(I)-2) 401,406,705


INPOUT
PAGE NO 6
401 NL=I
DO 404 J=1,J1
N=N+1
ROA(N)=RHOOA
ROB(N)=RHOOB
404 ROC(N)=RHOOC
J1=JF
GO TO 400
405 NL=I
DO 406 J=1,J1
N=N+1
ROA(N)=RHORA
ROB(N)=RHORB
406 ROC(N)=RHORC
J1=JF
GO TO 400
705 IF(MATL(I)-10) 400,400,706
706 K=MATL(I)-21
VKH=FLOAT(K)/2.0
KH=K/2

```
      IF(YKH-KH) 708,707,708

 707  ROCOM(I,1)=RHOR(KH,1)
      ROCOM(I,2)=RHOR(KH,2)
      ROCOM(I,3)=RHOR(KH,3)
      X(I)=0.

      GO TO 709

 708  KH=KH+1
      ROCOM(I,1)=RHOO(KH,1)
      ROCOM(I,2)=RHOO(KH,2)
      ROCOM(I,3)=RHOO(KH,3)
      X(I)=1.0

 709  IF(KH-KHS) 7090,7092,7090

7090  NFI(KH)=I
      KHS=KH
      NDBUCH=NDBUCH+1

7092  NLA(KH)=I

 400  CONTINUE

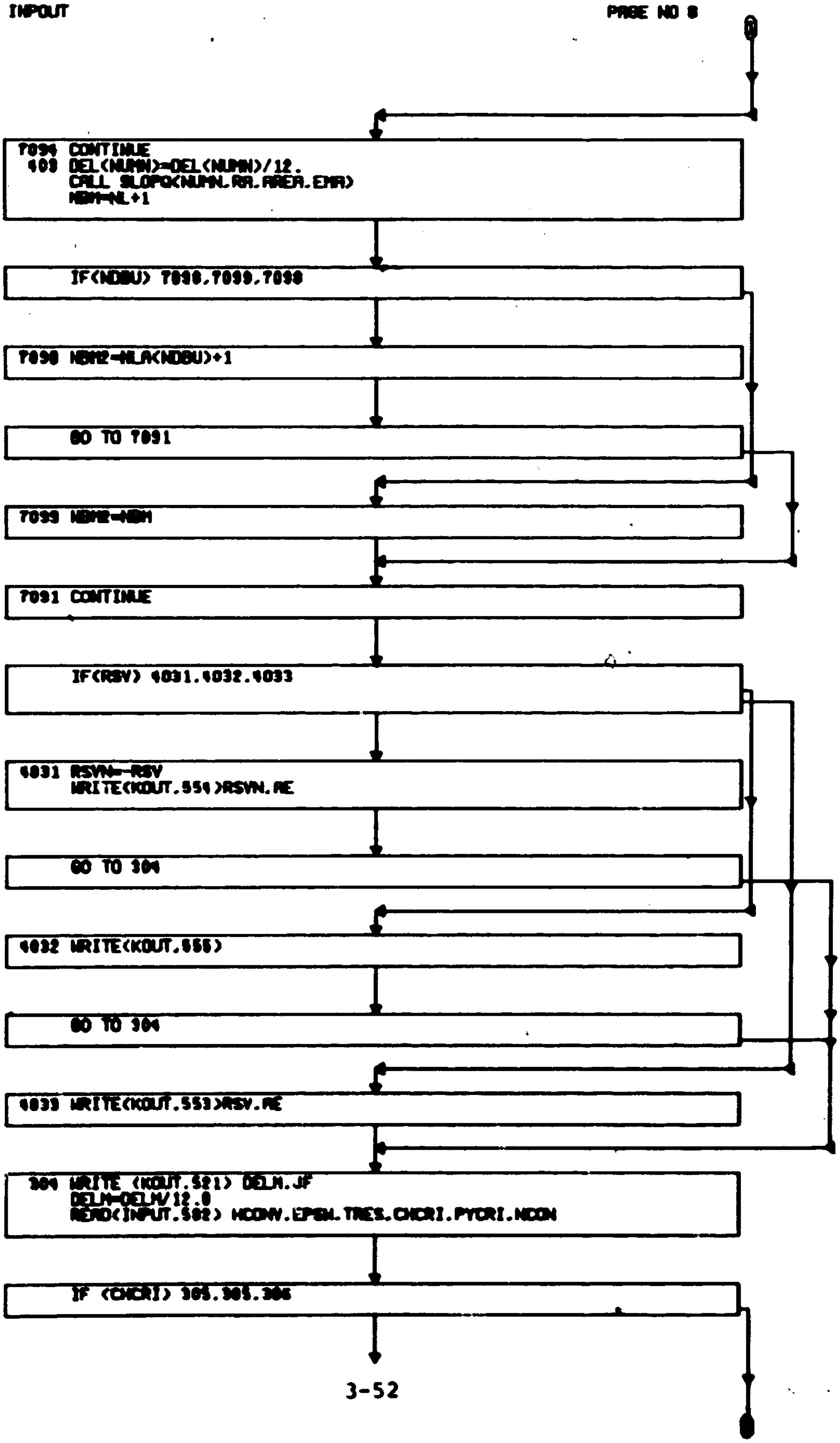
      IF(NDBU-NDBUCH) 7095,7094,7093

7095  WRITE(KOUT,7096)
7096  FORMAT(10X,55HTOO MANY DECOMPOSING BACK-UPS IN NODAL DATA -- QUIT
     1JOB)

      STOP

7093  WRITE(KOUT,7097)
7097  FORMAT(10X,54HTOO FEW DECOMPOSING BACK-UPS IN NODAL DATA -- QUIT J
     1OB)

      STOP
```


7094 CONTINUE
403 DEL(NUMN)=DEL(NUMN)/12.
CALL SLOPO(NUMN.RA.AREA.EMA)
NBM=NL+1
IF(NDBU) 7090,7099,7090
7090 NBM2=NLA(NDBU)+1
GO TO 7091
7099 NBM2=NBM
7091 CONTINUE
IF(RSV) 4031.4032.4033
4031 RSVN=-RSV
WRITE(KOUT.554)RSVN.AE
GO TO 304
4032 WRITE(KOUT.555)
GO TO 304
4033 WRITE(KOUT.553)RSV.AE
304 WRITE (KOUT.521) DELM.JF
DELM=DELM/12.0
READ(INPUT.502) KCONV.EPSM.TRES.CHCRI.PYCRI.NCON
IF (CHCRI) 305.305.306

```
305 CHCRI=0.02
```

```
306 IF (PYCRI) 307,307,308
```

```
307 PYCRI=0.98
```

```
308 TA(NUMN+1)=TRES
    CALL LCOUNT(4                    ,LCT,NPG,RECORD(35))
    WRITE(KOUT,681) HCONV,EPSN,TRES
    CALL LCOUNT(5                    ,LCT,NPG,RECORD(35))
    WRITE (KOUT,522)
    WRITE (KOUT,523)DH1,DH2,DELHO
    CALL LCOUNT(2                    ,LCT,NPG,RECORD(35))
    WRITE (KOUT,524)TZ
```

```
    IF(NDBU) 7910,7910,7907
```

```
7907 DO 7908 J=1,NDBU
```

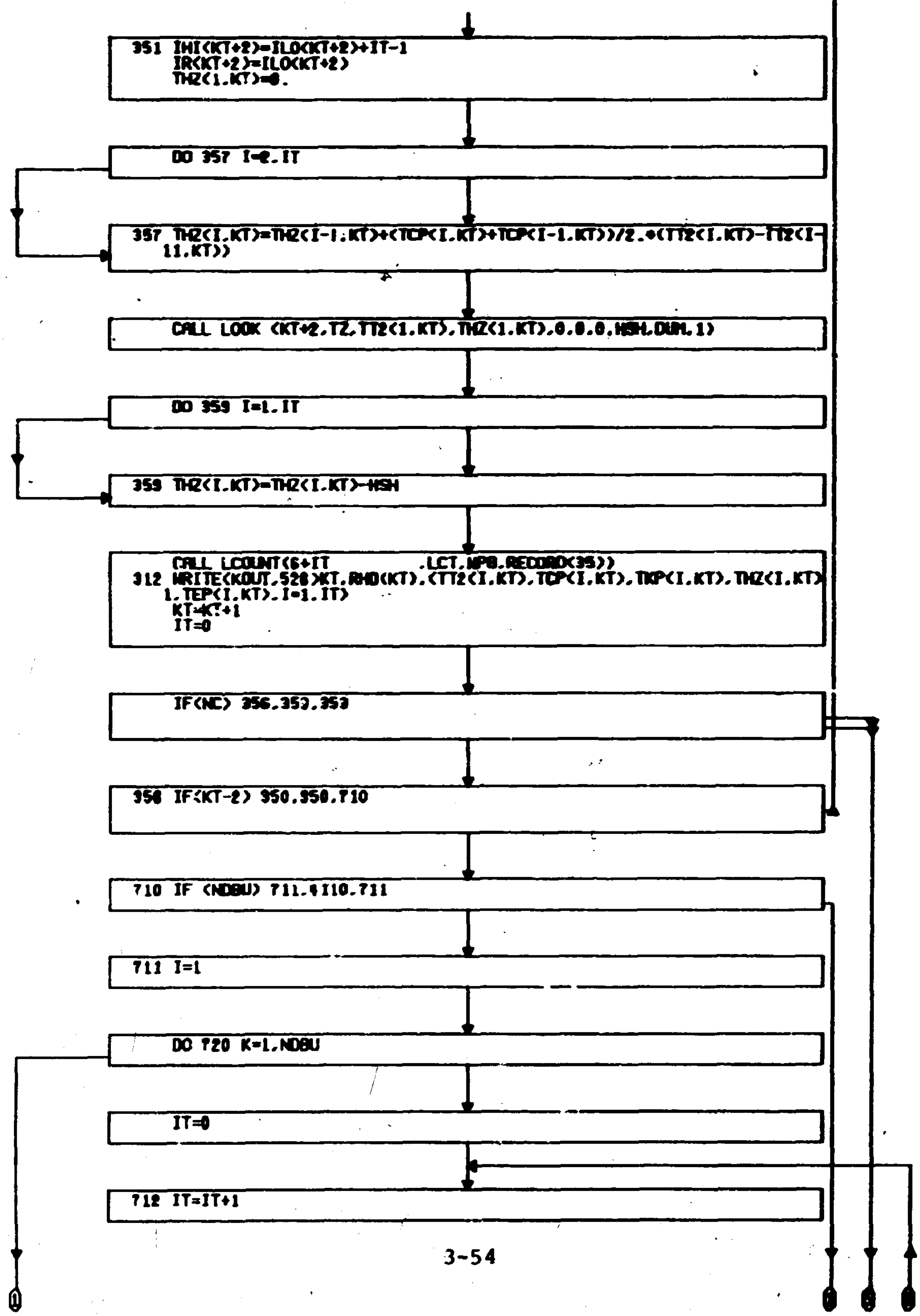
```
    CALL LCOUNT(9,LCT,NPG,RECORD(35))
    WRITE(KOUT,7902) J
    WRITE(KOUT,7903)
    WRITE(KOUT,523) DHV(J),DHC(J),DELHO
```

```
7908 WRITE(KOUT,524) TREF(J)
```

```
7910 CONTINUE
C    ---------  MATERIAL PROPERTIES
     CALL LCOUNT(6                    ,LCT,NPG,RECORD(35))
 310 WRITE (KOUT,525)
     CALL LCOUNT(9,LCT,NPG,RECORD(35))
     WRITE(KOUT,7905)
7905 FORMAT(/3X,82HDECOMPOSING BACK-UP VIRGIN MATERIALS 22,24,26,28,30,
   1 CHAR MATERIALS 23,25,27,29,31)
     IT=0
     ILO(3)=1
     ILO(4)=1
     KT=1
```

```
 350 IT=IT+1
     READ (INPUT,571) NC,TT2(IT,KT),TCP(IT,KT),TKP(IT,KT),TEP(IT,KT)
```

```
    IF(NC)351,350,351
```



351 IHI(KT+2)=ILO(KT+2)+IT-1
IR(KT+2)=ILO(KT+2)
THZ(1.KT)=0.
DO 357 I=2.IT
357 THZ(I.KT)=THZ(I-1.KT)+(TCP(I.KT)+TCP(I-1.KT))/2.*(TT2(I.KT)-TT2(I-
11.KT))
CALL LOOK (KT+2.TZ.TT2(1.KT).THZ(1.KT).0.0.0.HSH.DUM.1)
DO 359 I=1.IT
359 THZ(I.KT)=THZ(I.KT)-HSH
CALL LCOUNT(6+IT .LCT.NP0.RECORD(35))
312 WRITE(KOUT.520)KT.RHO(KT).(TT2(I.KT).TCP(I.KT).TKP(I.KT).THZ(I.KT)
1.TEP(I.KT).I=1.IT)
KT=KT+1
IT=0
IF(NC) 356.353.353
356 IF(KT-2) 350.350.710
710 IF (NDBU) 711.4110.711
711 I=1
DO 720 K=1.NDBU
IT=0
712 IT=IT+1

```
      READ(INPUT.571) NC.TT5(IT.I).TCBU(IT.I).TKBU(IT.I)

      IF(NC) 713.712.713

713   IHI(I+21)=IT
      ILO(I+21)=1
      IR(I+21)=1
      TENT(1.I)=0.

      DO 714 J=2.IT

714   TENT(J.I)=TENT(J-1.I)+(TCBU(J.I)+TCBU(J-1.I))/2.*(TT5(J.I)-TT5(J-1
     1.I))

      CALL LOOK(21+I.TREF(K).TT5(1.I).TENT(1.I).0.0.0.HSH.DUM.1)

      DO 715 J=1.IT

715   TENT(J.I)=TENT(J.I)-HSH

      IF(2*K-I) 717.716.717

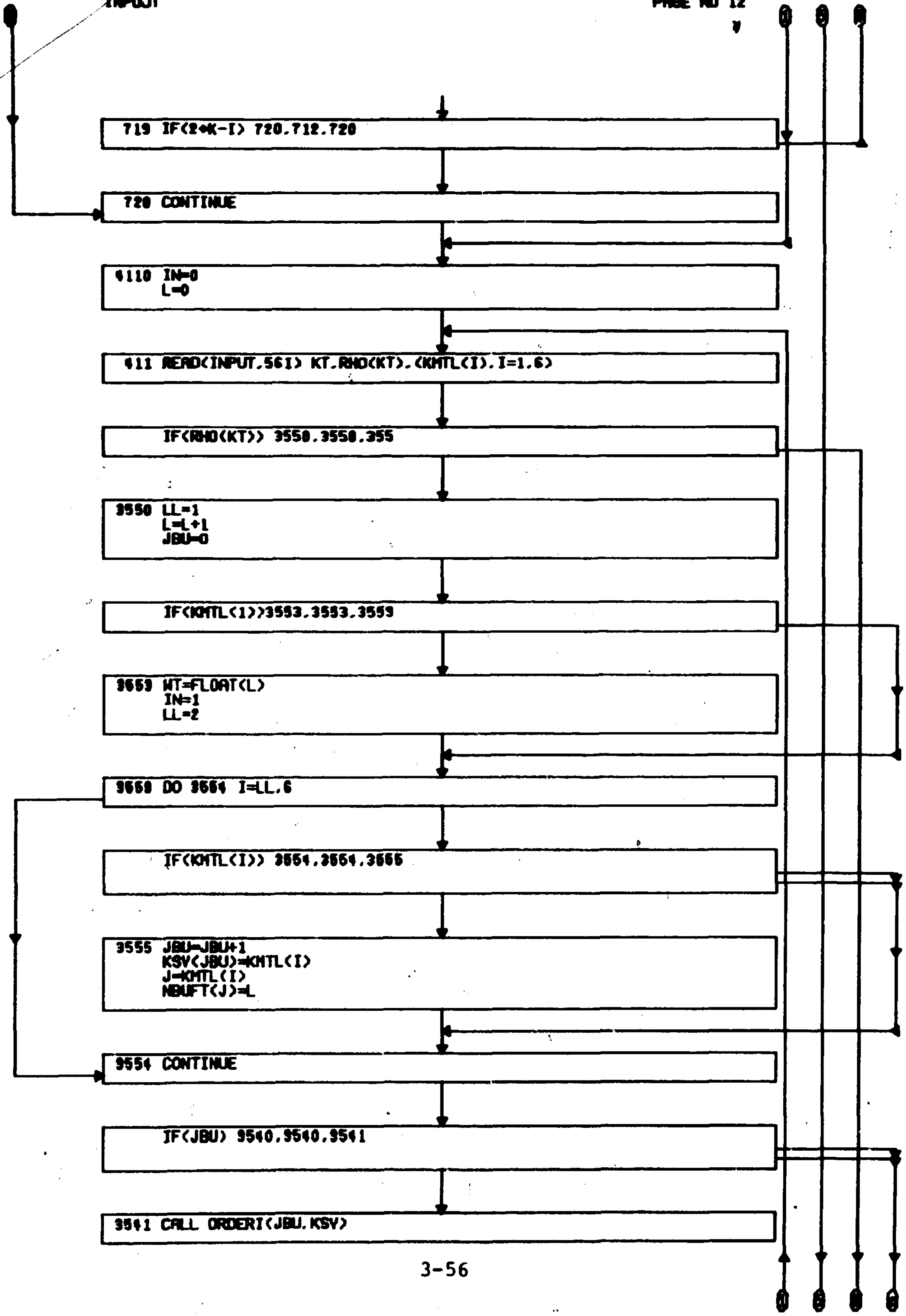
716   RRR=RHOC(K)

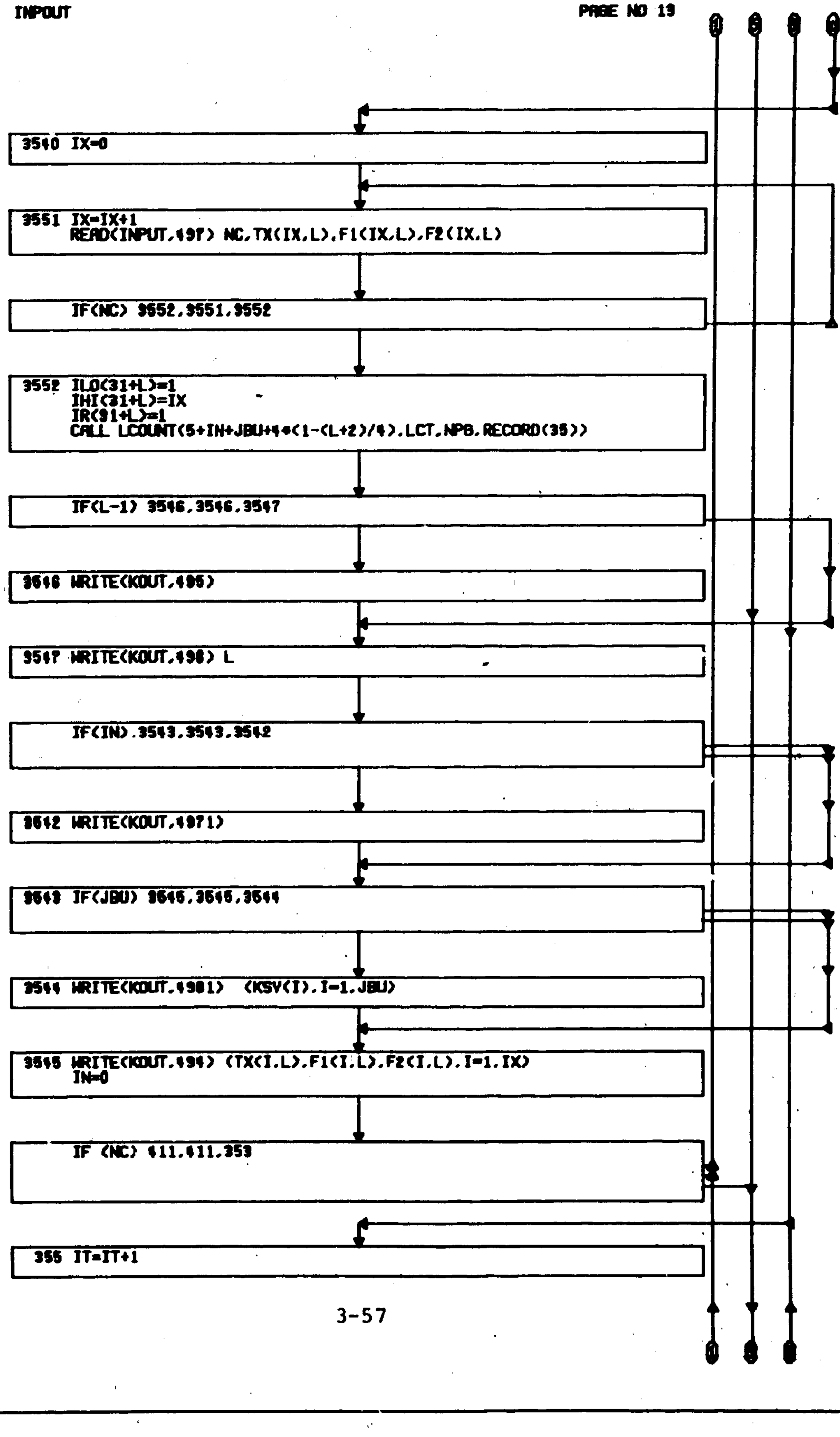
      GO TO 718

717   RRR=RHOV(K)

718   CALL LCOUNT(6+IT.LCT.NPG.RECORD(35))
      L=I+21
      WRITE(KOUT.5260)   L.RRR.(TT5(J.I).TCBU(J.I).TKBU(J.I).TENT(J.I).
     1J=1.IT)
      I=I+1
      IT=0

      IF(NC) 719.353.353
```


719 IF(2*K-I) 720.712.720
720 CONTINUE
4110 IN=0
L=0
411 READ(INPUT.561) KT.RHO(KT).(KMTL(I).I=1.6)
IF(RHO(KT)) 3550.3550.355
3550 LL=1
L=L+1
JBU=0
IF(KMTL(1))3553.3553.3559
3553 WT=FLOAT(L)
IN=1
LL=2
3558 DO 3554 I=LL.6
IF(KMTL(I)) 3554.3554.3555
3555 JBU=JBU+1
KSV(JBU)=KMTL(I)
J=KMTL(I)
NBUFT(J)=L
3554 CONTINUE
IF(JBU) 3540.3540.3541
3541 CALL ORDERI(JBU.KSV)


3540 IX=0
3551 IX=IX+1
READ(INPUT,497) NC,TX(IX,L),F1(IX,L),F2(IX,L)
IF(NC) 3552,3551,3552
3552 ILO(31+L)=1
IHI(31+L)=IX
IR(31+L)=1
CALL LCOUNT(5+IN+JBU+4*(1-(L+2)/4),LCT,NPB,RECORD(35))
IF(L-1) 3546,3546,3547
3546 WRITE(KOUT,495)
3547 WRITE(KOUT,498) L
IF(IN) 3543,3543,3542
3542 WRITE(KOUT,4971)
3543 IF(JBU) 3545,3545,3544
3544 WRITE(KOUT,4981) (KSV(I),I=1,JBU)
3545 WRITE(KOUT,494) (TX(I,L),F1(I,L),F2(I,L),I=1,IX)
IN=0
IF (NC) 411,411,353
355 IT=IT+1

```
      READ (INPUT.571) NC.TT2(IT.KT).TCP(IT.KT).TKP(IT.KT)

      IF(NC) 354.355.354

 354  ILO(KT+2)=1
      IHI(KT+2)=ILO(KT+2)+IT-1
      IR(KT+2)=ILO(KT+2)
      CALL LCOUNT(5+IT           .LCT.NPG.RECORD(95))
 314  WRITE (KOUT.527) KT.RHO(KT).(TT2(I.KT).TCP(I.KT).TKP(I.KT).I=1.IT)
      IT=0

      IF(NC) 411.411.959

C     ---------- PYROLYSIS GAS ENTHALPY

 353  NT1=0

 381  IN=1+NT1
      NT1=8+NT1
      READ  (INPUT.576)NC.(TT1(I).I=IN.NT1).(THG(I).I=IN.NT1)

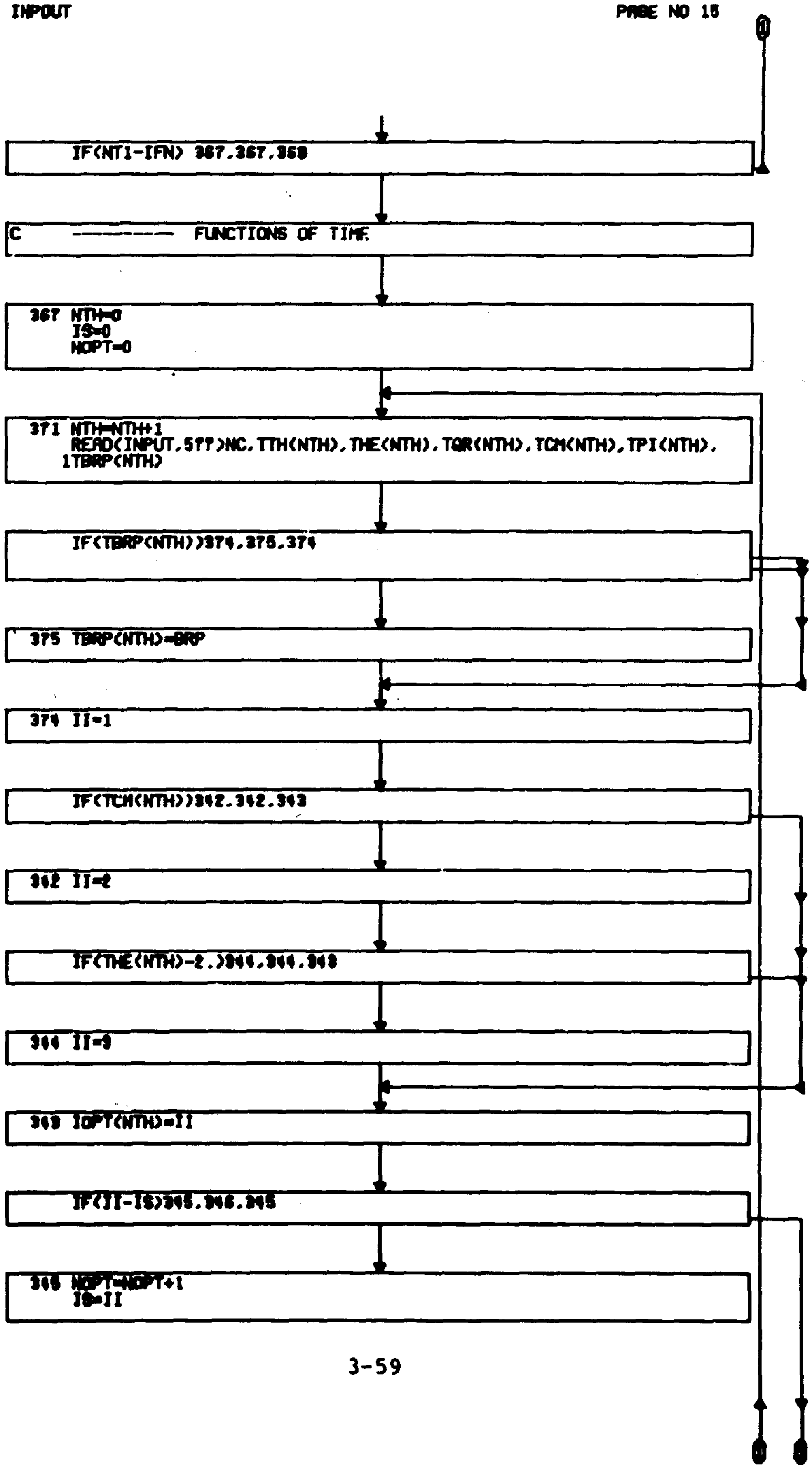
      IF(NC)381.381.382

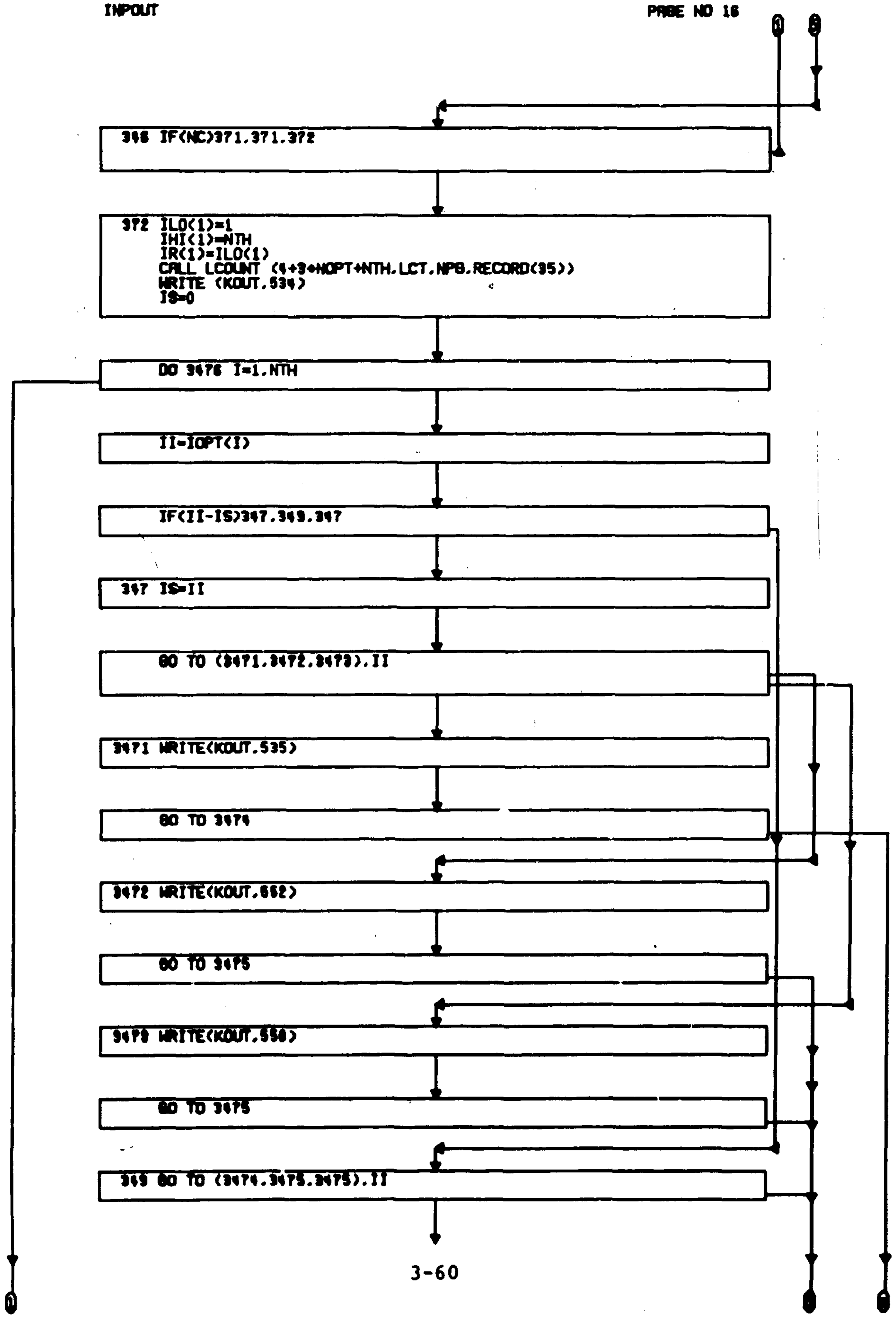
 384  NT1=NT1-1

 382  IF(TT1(NT1)) 384.384.385

 385  ILO(2)=1
      IR(2)=1
      IHI(2)=NT1
      CALL LCOUNT(3*((NT1+8)/5).LCT.NPG.RECORD(95))
 316  WRITE (KOUT.532)
      IFN=0

 388  IN=IFN+1
      IFN=MIN0(NT1.IFN+5)
      WRITE (KOUT.581)(TT1(I).I=IN.IFN )
      WRITE (KOUT.593)(THG(I).I=IN.IFN)
```


IF(NT1-IFN) 367.367.368
C ---------- FUNCTIONS OF TIME
367 NTH=0
IS=0
NOPT=0
371 NTH=NTH+1
READ(INPUT,577)NC,TTH(NTH),THE(NTH),TQR(NTH),TCM(NTH),TPI(NTH),
1TBRP(NTH)
IF(TBRP(NTH))374,375,374
375 TBRP(NTH)=BRP
374 II=1
IF(TCM(NTH))342.342.343
342 II=2
IF(THE(NTH)-2.)344,344,343
344 II=3
343 IOPT(NTH)=II
IF(II-IS)345,346,345
345 NOPT=NOPT+1
IS=II


346 IF(NC)371.371.372
372 ILO(1)=1
IHI(1)=NTH
IR(1)=ILO(1)
CALL LCOUNT (4+3+NOPT+NTH.LCT.NPG.RECORD(35))
WRITE (KOUT.534)
IS=0
DO 3476 I=1.NTH
II=IOPT(I)
IF(II-IS)347.349.347
347 IS=II
GO TO (3471.3472.3473).II
3471 WRITE(KOUT.535)
GO TO 3474
3472 WRITE(KOUT.662)
GO TO 3475
3473 WRITE(KOUT.558)
GO TO 3475
349 GO TO (3474.3475.3475).II

```
3474 WRITE(KOUT,536) TTH(I),II,THE(I),TGR(I),TCM(I),TPI(I),TBRP(I)

     GO TO 3476

3475 WRITE(KOUT,516) TTH(I),II,THE(I),TGR(I)

3476 CONTINUE

     IF(NC-1) 379,379,749

 379 DO 3791 I=1,NTH

3791 TPI(I)=ALOG(AMAX1(TPI(I),.000001))

     CALL LCOUNT(2            ,LCT,NPG,RECORD(35))
 328 WRITE (KOUT,537)
C    ------------SURFACE EQUILIBRIUM TABLE
     READ(INPUT,5796) CMHS,VFZ,BREX,NR,NST,NBPF,NFIS,SWELL
     NFIS=NFIS+1

     IF(NST) 2900,2900,2901

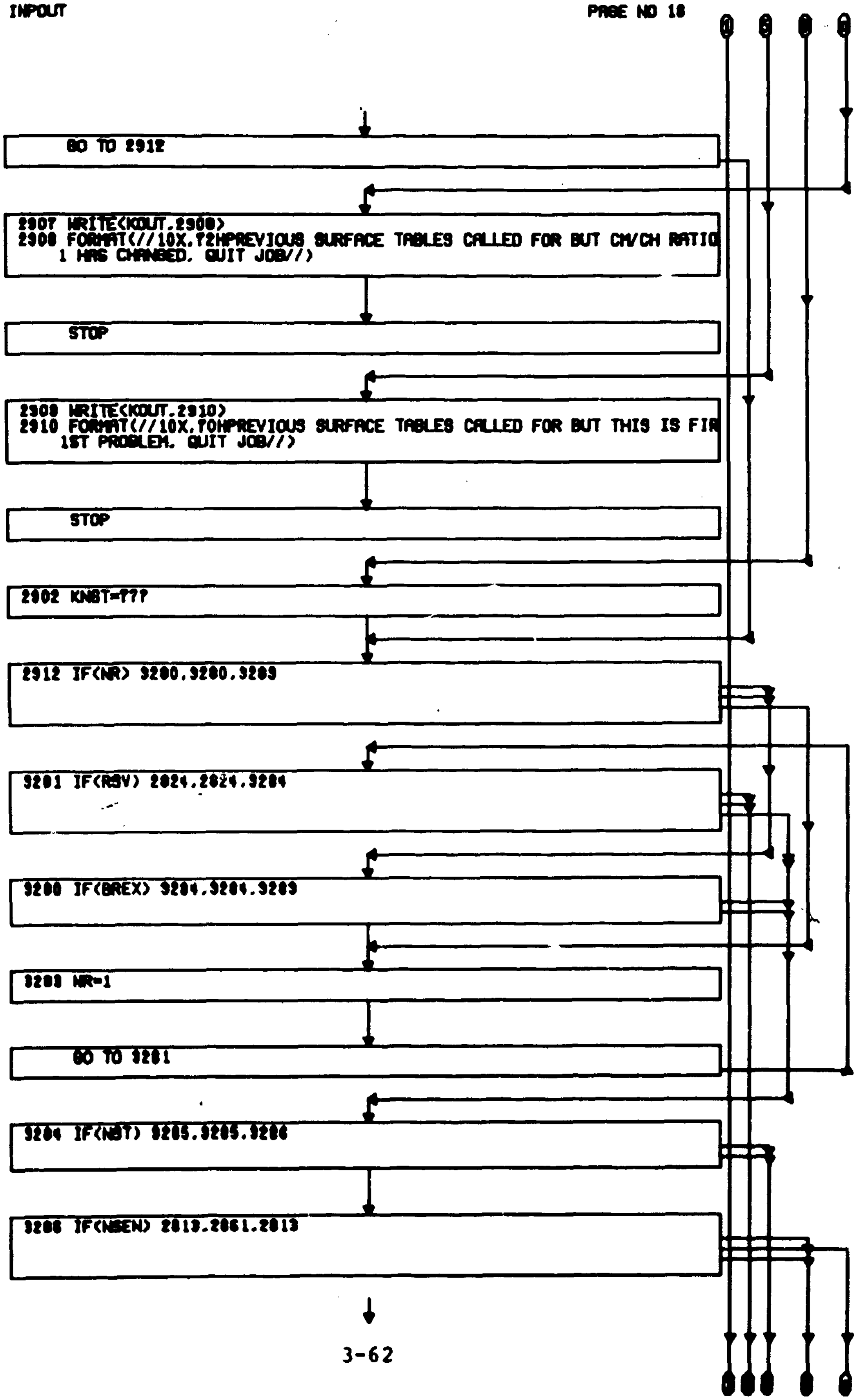
2900 CMH=CMHS

     GO TO 2902

2901 IF(KNST-777) 2909,2903,2909

2903 IF(CMH-CMHS) 2907,2905,2907

2905 WRITE(KOUT,2906)
     CALL LCOUNT(3,LCT,NPG,RECORD(35))
2906 FORMAT(//10X50HSURFACE TABLES ARE THE SAME AS IN PREVIOUS PROBLEM)
```


GO TO 2912
2907 WRITE(KOUT,2908)
2908 FORMAT(//10X,72HPREVIOUS SURFACE TABLES CALLED FOR BUT CH/CH RATIO
1 HAS CHANGED. QUIT JOB//)
STOP
2909 WRITE(KOUT,2910)
2910 FORMAT(//10X,70HPREVIOUS SURFACE TABLES CALLED FOR BUT THIS IS FIR
1ST PROBLEM. QUIT JOB//)
STOP
2902 KNST=777
2912 IF(NR) 3200,3200,3203
3201 IF(RSV) 2024,2024,3204
3200 IF(BREX) 3204,3204,3203
3203 NR=1
GO TO 3201
3204 IF(NST) 3205,3205,3206
3206 IF(NSEN) 2013,2061,2013

```
3285 CONTINUE
     WLS=-1
     NSEN=-1
     IP=1
     IPN=1
     I=1
     IN=1
     J=0

2800 J=J+1

     IF(NBPF) 28001.28000.28001

28000 READ(INCH.5791) PSV.DMS.TLMC(J.I.IP).TTS(J.I.IP).WLQ.TCHEM(J.I.IP)
     1.TSEN(J).JNS.TSURF(J)
      TBPF(J.I.IP)=0.

     GO TO 28002

28001 READ(INCH.5700)PSV.DMS.TLMC(J.I.IP).TTS(J.I.IP).WLQ.TCHEM(J.I.IP)
     1.TSEN(J).JNS.TSURF(J).TBPF(J.I.IP)

28002 CONTINUE

     IF(JNS) 2817.2817.2821

2817 TSURF(J)=BLANK

2821 CONTINUE

     IF(TTS(J.I.IP)) 2803.2832.2801

2801 TTS(J.I.IP)=TTS(J.I.IP)*1.0
     TCHEM(J.I.IP)=TCHEM(J.I.IP)*1.0
     TSEN(J)=TSEN(J)*1.0

     GO TO 2805
```

```
2003 TTS(J.I.IP)=-TTS(J.I.IP)

2005 IF(WLS) 2009.2007.2007

2007 IX=4

     IF(WLS-WLQ) 2024.2011.2024

2009 WLS=WLQ

2011 IF(NSEN) 2002.2020.2020

2002 IF(JNB) 2000.2004.2004

2004 NSEN=J-1
     ISEN(IP)=NSEN

     IF(NSEN-1) 2020.2020.2000

2000 DO 2006 L=1.NSEN

     TTSEN(L.IP)=TTS(L.1.IP)
     TZSEN(L.IP)=TCHEM(L.1.IP)

2006 THSEN(L.IP)=TSEN(L)

     CALL SLOPG(NSEN.TTSEN(1.IP).THSEN(1.IP).TCPSEN(1.IP))
     CALL SLOPG(NSEN.TTSEN(1.IP).TZSEN(1.IP).TCZSEN(1.IP))
     LLL=(NSEN-1)/3+1

     IF(IP-1)20137.2013.20137
```

```
2013 CALL LCOUNT(11+2*NR,LCT    ,NPG,RECORD(35))
     WRITE (KOUT,530)
     WRITE (KOUT,5797) CMH,HLQ,VFZ

     GO TO(20130,20131),NFIS

20131 WRITE(KOUT,20132)
20132 FORMAT(6X,86HFISSURE MODEL USED FOR SURFACE ENERGY TERMS AND BLOWI
    1NG CORRECTION)

     GO TO 20133

20130 WRITE(KOUT,20612)

20133 CONTINUE

     IF (NR) 2018,2018,2016

2016 WRITE (KOUT,5799) BREX

     GO TO 2015

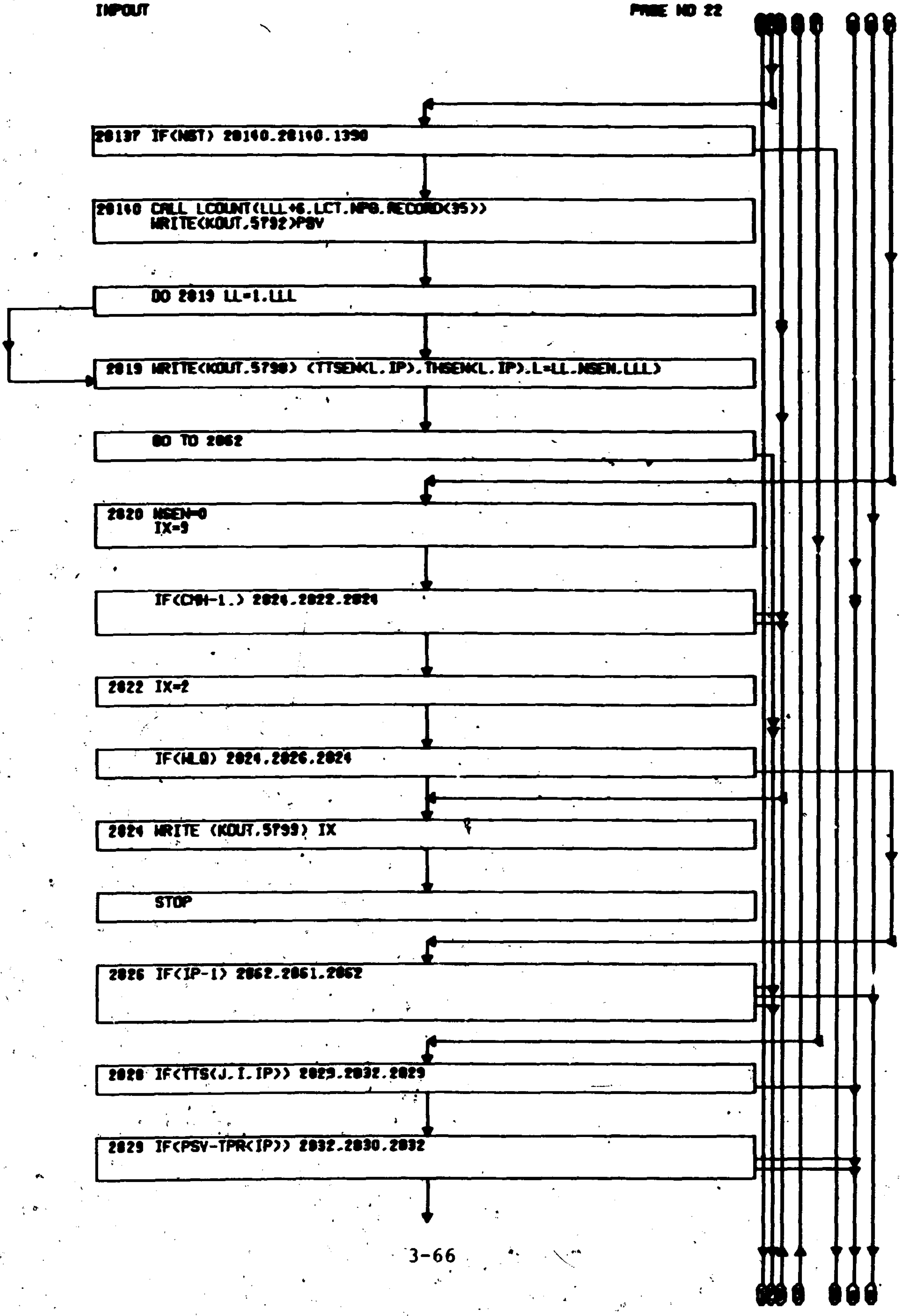
2018 WRITE (KOUT,5790)

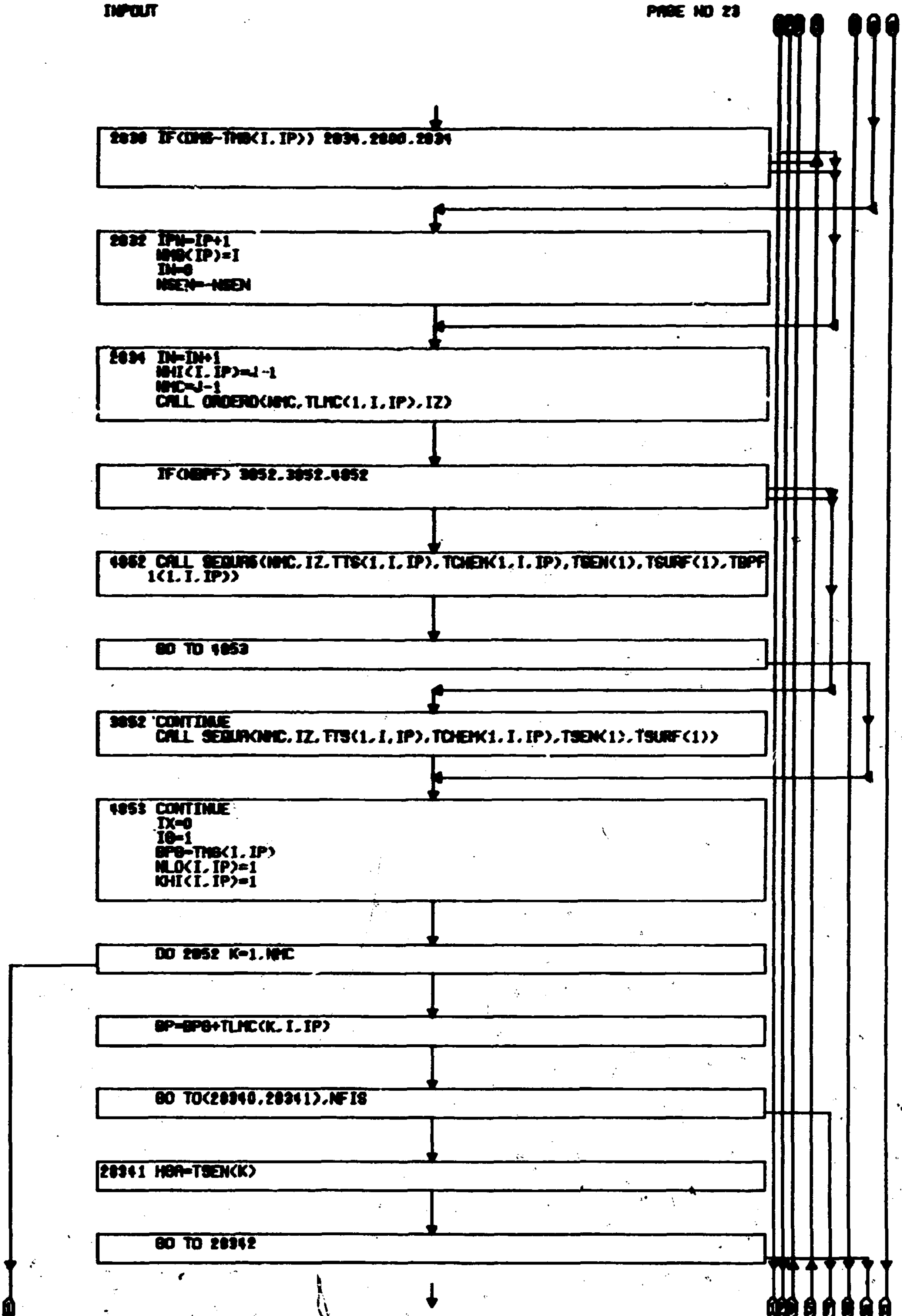
2015 IF(SWELL) 20134,20135,20134

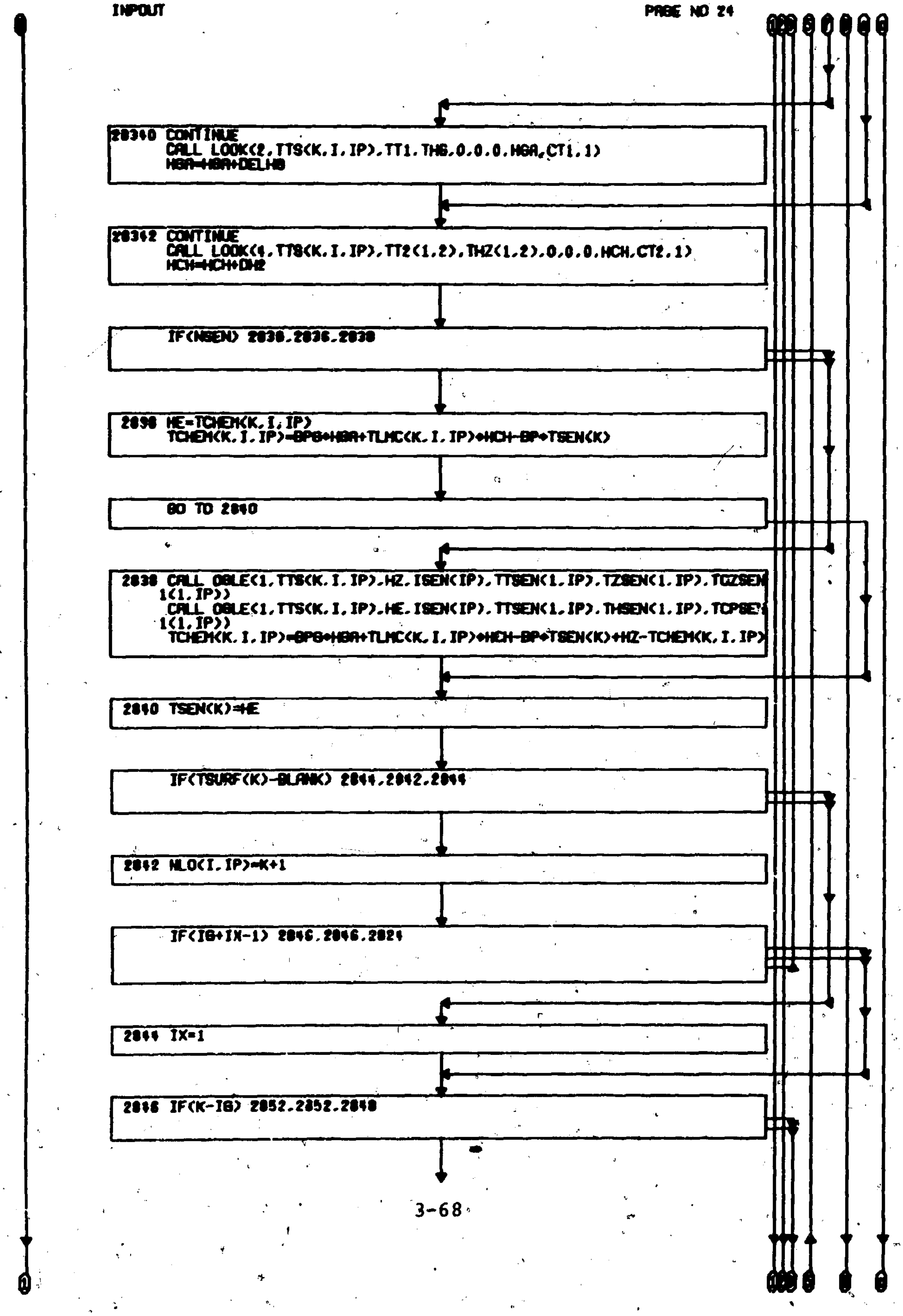
20135 WRITE(KOUT,20136)
20136 FORMAT(6X,45HNO CHAR SWELL CORRECTION ON SURFACE RECESSION)

     GO TO 20137

20134 WRITE(KOUT,20138) SWELL
20138 FORMAT(6X,12HCHAR SWELL =F8.4,1X16H CHAR THICKNESS)
```


28137 IF(NST) 28140.28140.1390
28140 CALL LCOUNT(LLL+6.LCT.NPG.RECORD(35))
WRITE(KOUT.5792)PSV
DO 2819 LL=1.LLL
2819 WRITE(KOUT.5790) (TTSEN(L.IP).THSEN(L.IP).L=LL.NSEN.LLL)
GO TO 2862
2820 NSEN=0
IX=3
IF(CMH-1.) 2824.2822.2824
2822 IX=2
IF(WLQ) 2824.2826.2824
2824 WRITE (KOUT.5793) IX
STOP
2826 IF(IP-1) 2862.2861.2862
2828 IF(TTS(J.I.IP)) 2829.2832.2829
2829 IF(PSV-TPR(IP)) 2832.2830.2832


2830 IF(DMS-TMS(I.IP)) 2834.2880.2834
2832 IP=IP+1
NMS(IP)=I
IN=0
NSEN=-NSEN
2834 IN=IN+1
NHI(I.IP)=J-1
NMC=J-1
CALL ORDERD(NMC,TLMC(1,I,IP),IZ)
IF(NBPF) 3052.3052.4052
4052 CALL SEQUR6(NMC,IZ,TTS(1,I,IP),TCHEM(1,I,IP),TSEN(1),TSURF(1),TBPF
1(1,I,IP))
GO TO 4053
3052 CONTINUE
CALL SEQUR(NMC,IZ,TTS(1,I,IP),TCHEM(1,I,IP),TSEN(1),TSURF(1))
4053 CONTINUE
IX=0
IG=1
BPG=TMS(I,IP)
NLO(I,IP)=1
KHI(I,IP)=1
DO 2052 K=1,NMC
BP=BPG+TLMC(K,I,IP)
GO TO(20340,20341),NFIS
20341 HGA=TSEN(K)
GO TO 20342


28340 CONTINUE
CALL LOOK(2,TTS(K,I,IP),TT1,THG,0,0,0,HGA,CT1,1)
HGA=HGA+DELHG
28342 CONTINUE
CALL LOOK(4,TTS(K,I,IP),TT2(1,2),THZ(1,2),0,0,0,HCH,CT2,1)
HCH=HCH+DH2
IF(NSEN) 2838,2836,2838
2836 HE=TCHEM(K,I,IP)
TCHEM(K,I,IP)=BPG+HGA+TLMC(K,I,IP)+HCH-BP+TSEN(K)
GO TO 2840
2838 CALL OBLE(1,TTS(K,I,IP),HZ,ISEN(IP),TTSEN(1,IP),TZSEN(1,IP),TGZSEN
1(1,IP))
CALL OBLE(1,TTS(K,I,IP),HE,ISEN(IP),TTSEN(1,IP),THSEN(1,IP),TCPSEN
1(1,IP))
TCHEM(K,I,IP)=BPG+HGA+TLMC(K,I,IP)+HCH-BP+TSEN(K)+HZ-TCHEM(K,I,IP)
2840 TSEN(K)=HE
IF(TSURF(K)-BLANK) 2844,2842,2844
2842 NLO(I,IP)=K+1
IF(IG+IX-1) 2846,2846,2824
2844 IX=1
2846 IF(K-IG) 2852,2852,2848

```
2849 IF(TTS(K,I,IP)-TTS(K-1,I,IP)) 2850,2850,2851

2850 IG=NMC

     GO TO 2852

2851 KHI(I,IP)=K

2852 CONTINUE

     LLL=(NMC-1)/2+1
     CALL LCOUNT(LLL+6          ,LCT,NPG,RECORD(35))
     WRITE(KOUT,5795)TMO(I,IP),TPR(IP),((TTS(L,I,IP),TLMC(L,I,IP),TCHEM
    1(L,I,IP),TSURF(L),L=LL,NMC,LLL),LL=1,LLL)

     DO 2856 K=1,NMC

     TCHEM(K,I,IP)=CMH*TCHEM(K,I,IP)-TSEN(K)

     IF(K-NLO(I,IP)) 2856,2854,2854

2854 TLMC(K,I,IP)=ALOG(AMAX1(TLMC(K,I,IP),.00001))

     IF(NBPF) 2856,2856,3856

3856 TBPF(K,I,IP)=ALOG(AMAX1(TBPF(K,I,IP),1.E-12))

2856 CONTINUE

     CALL SSWTCH(1,KKSW)

     GO TO (730,731),KKSW
```

```
730 CALL LCOUNT(LLL+6,LCT,NPG,RECORD(35))
    WRITE(KOUT,5795)TMS(I,IP),TPR(IP),((TTS(L,I,IP),TLMC(L,I,IP),TCHEM
   1(L,I,IP),TSEN(L) ,L=LL,NMC,LLL),LL=1,LLL)

    IF(NBPF) 731,731,6016

6016 CALL LCOUNT(9+NMC,LCT,NPG,RECORD(35))
    WRITE(KOUT,6017) (TBPF(L,I,IP),L=1,NMC)

731 CONTINUE

    IF(TTS(J,I,IP)) 2862,2870,2862

2861 CALL LCOUNT(10+2*NR,LCT,NPG,RECORD(35))
    *WRITE (KOUT,598)
    WRITE (KOUT,5794) VFZ

    GO TO (28610,28611),NFIS

28611 WRITE(KOUT,28132)

    GO TO 28613

28610 WRITE(KOUT,28612)
28612 FORMAT(6X,36HFISSURE MODEL NOT USED FOR GAS TERMS)

28613 CONTINUE

    IF (NR) 2863,2863,2864

2864 WRITE(KOUT,5799) BREX

    GO TO 2715
```

```
2863 WRITE (KOUT.5790)

2715 IF(SWELL) 2734,2735,2734

2735 WRITE(KOUT,28138)

     GO TO 2737

2734 WRITE(KOUT,28138) SWELL

2737 IF(NST) 2862.2862.1390

2862 TPR(IPN)=PSV
     TMS(IN.IPN)=DMS
     TLMC(1.IN.IPN)=TLMC(J.I.IP)
     TBPF(1,IN.IPN)=TBPF(J.I.IP)
     TTS (1.IN.IPN)=TTS (J.I.IP)
     TCHEM(1,IN,IPN)=TCHEM(J.I.IP)
     TSURF(1)=TSURF(J)
     TSEN(1)=TSEN(J)
     J=1
     I=IN
     IP=IPN

     GO TO 2800

2870 NPR=IP
     IR(12)=1
     ILO(12)=1
     IHI(12)=I

     DO 2872 I=1.IP

2872 TPR(I)=ALOG(TPR(I))

     IR(13)=1
     IHI(13)=NPR
     ILO(13)=1
```

```
743 IF(NDBU) 740,1390,740

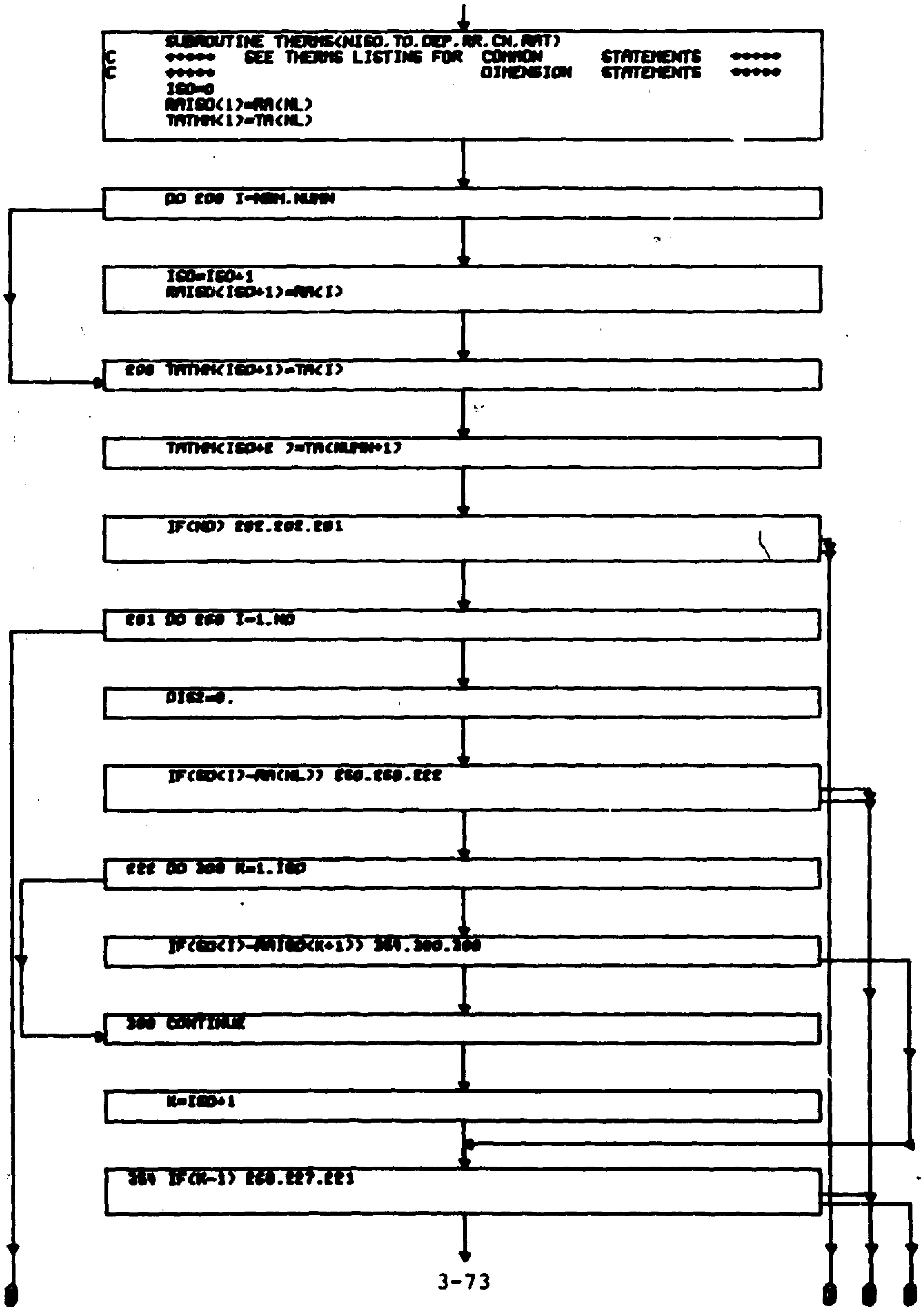
740 CALL SSWTCH(3,KKSW)

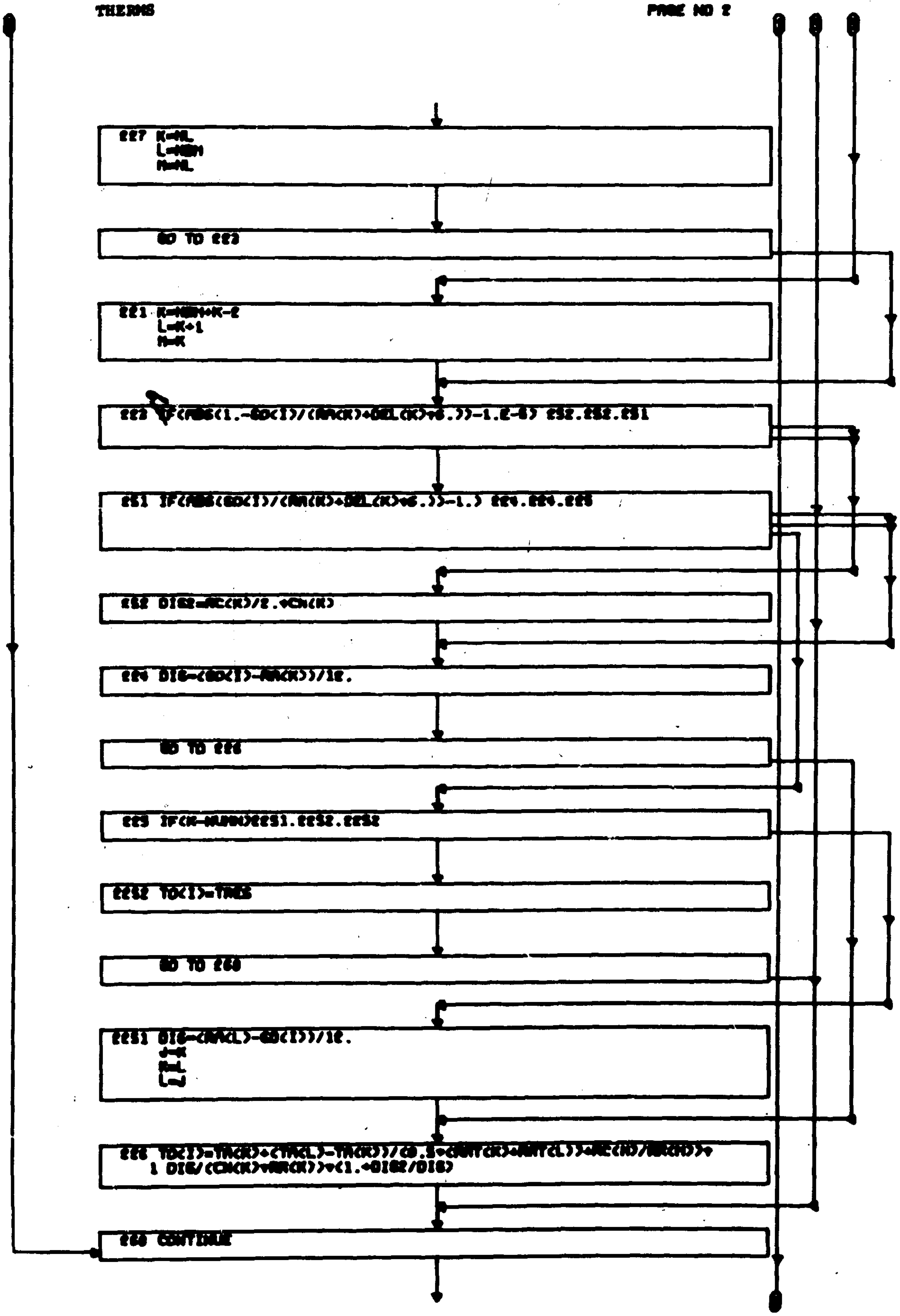
    GO TO (741,1390),KKSW

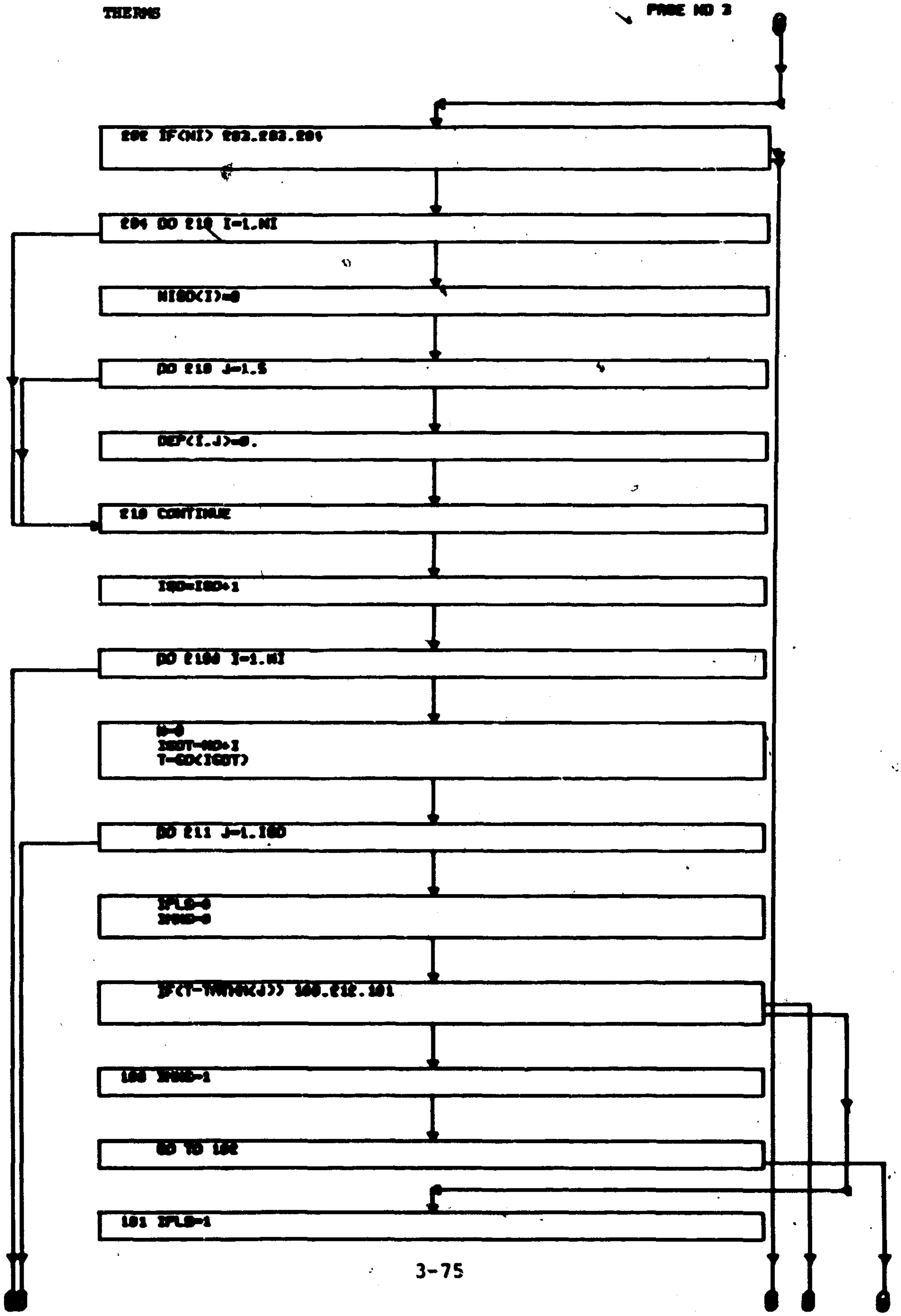
741 WRITE(KOUT,742) (NFI(J), J=1,NDBU)
    WRITE(KOUT,742) (NLA(J), J=1,NDBU)
    WRITE(KOUT,742) NDBU,NBM2
    LU=NDBU*2+21
    WRITE(KOUT,742) (IHI(J),ILO(J),IR(J),J=22,LU)

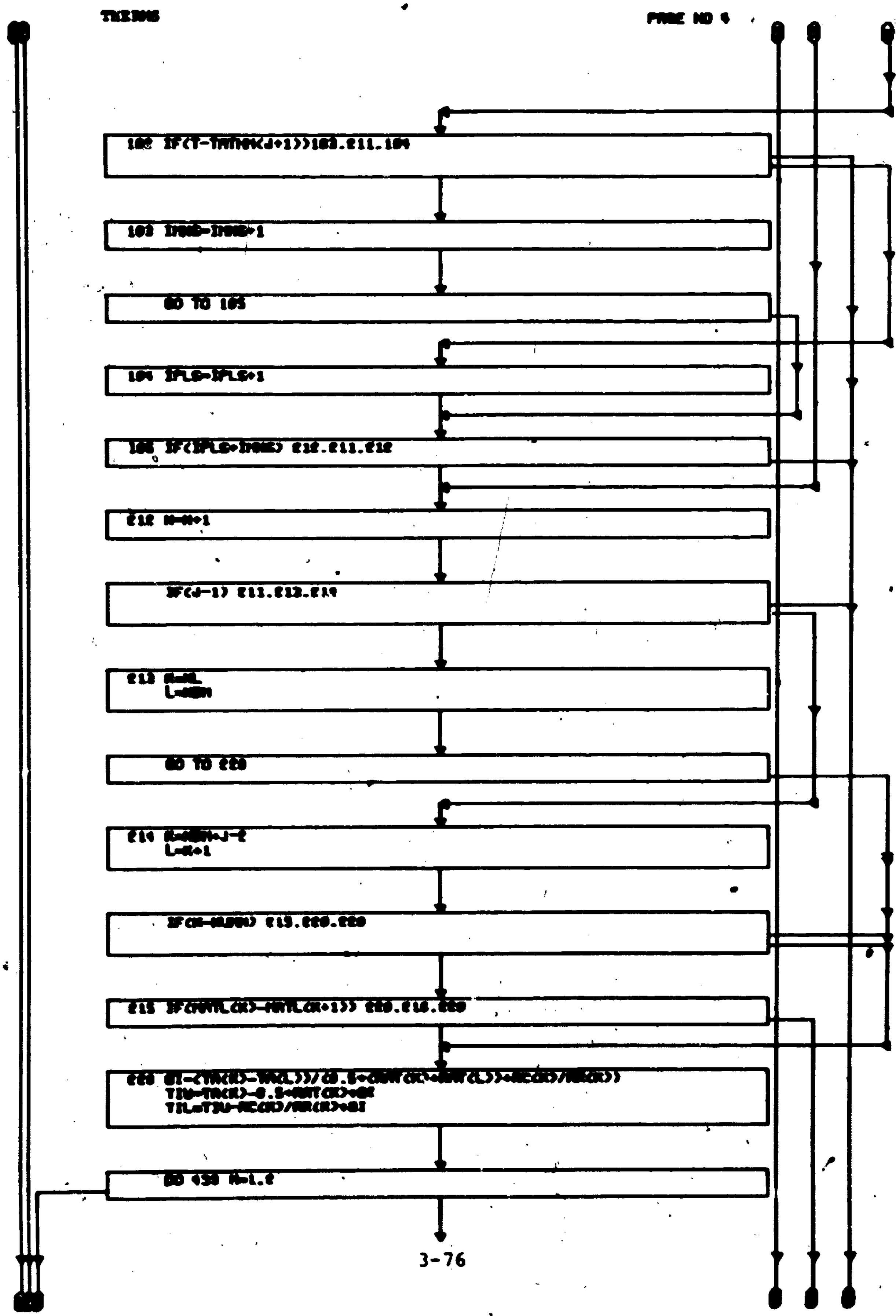
1390 RETURN

    END
```

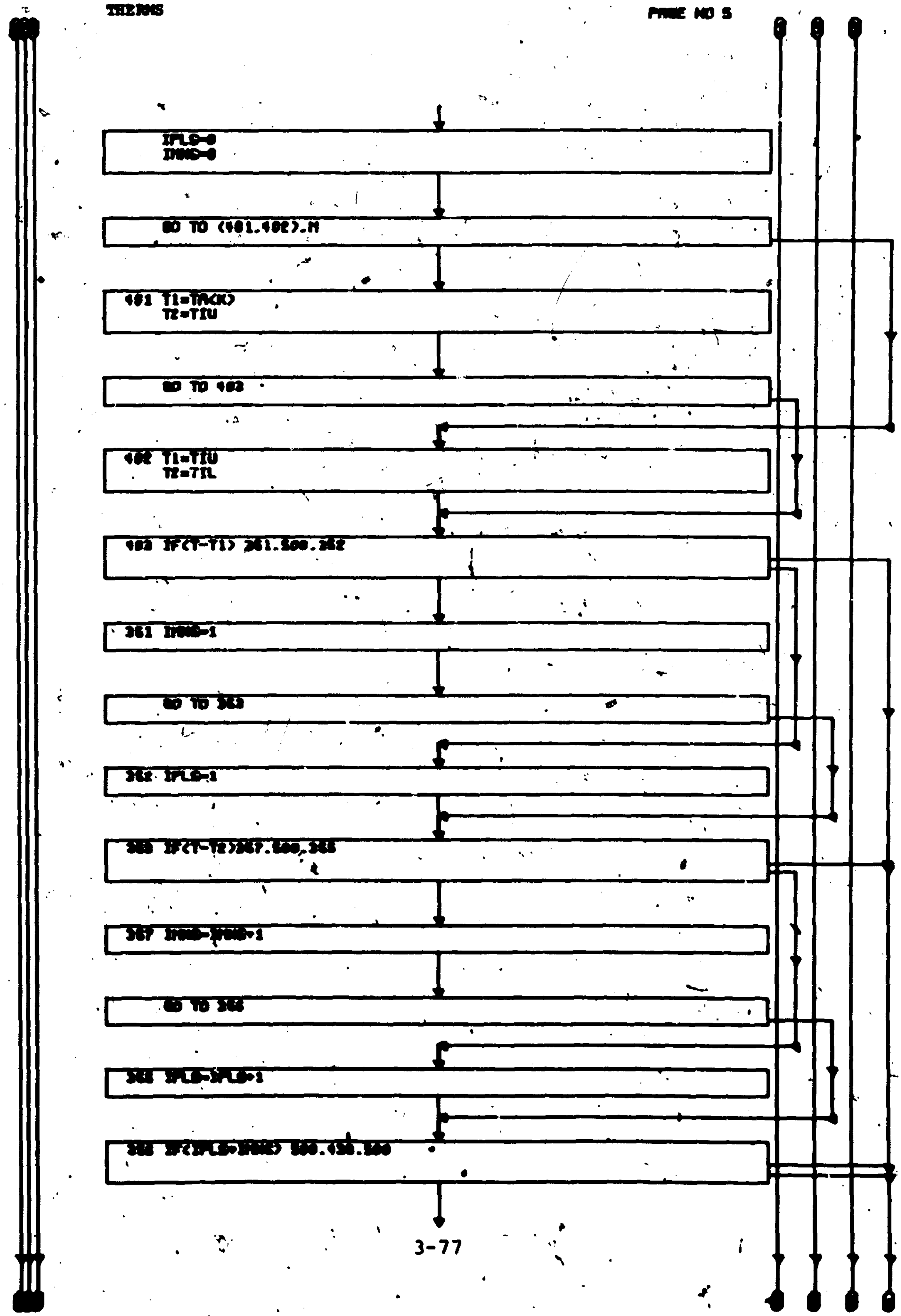

SUBROUTINE THERMS(NISO.TO.DEP.RR.CN.RAT)
C ***** SEE THERMS LISTING FOR COMMON STATEMENTS *****
C ***** DIMENSION STATEMENTS *****
ISO=0
RAISO(1)=RR(NL)
TATHM(1)=TA(NL)
DO 200 I=NBM.NUMN
ISO=ISO+1
RAISO(ISO+1)=RR(I)
200 TATHM(ISO+1)=TA(I)
TATHM(ISO+2)=TA(NUMN+1)
IF(ND) 202.202.201
201 DO 260 I=1.ND
DIS2=0.
IF(SD(I)-RR(NL)) 260.260.222
222 DO 300 K=1.ISO
IF(SD(I)-RAISO(K+1)) 304.300.300
300 CONTINUE
K=ISO+1
304 IF(K-1) 260.227.221

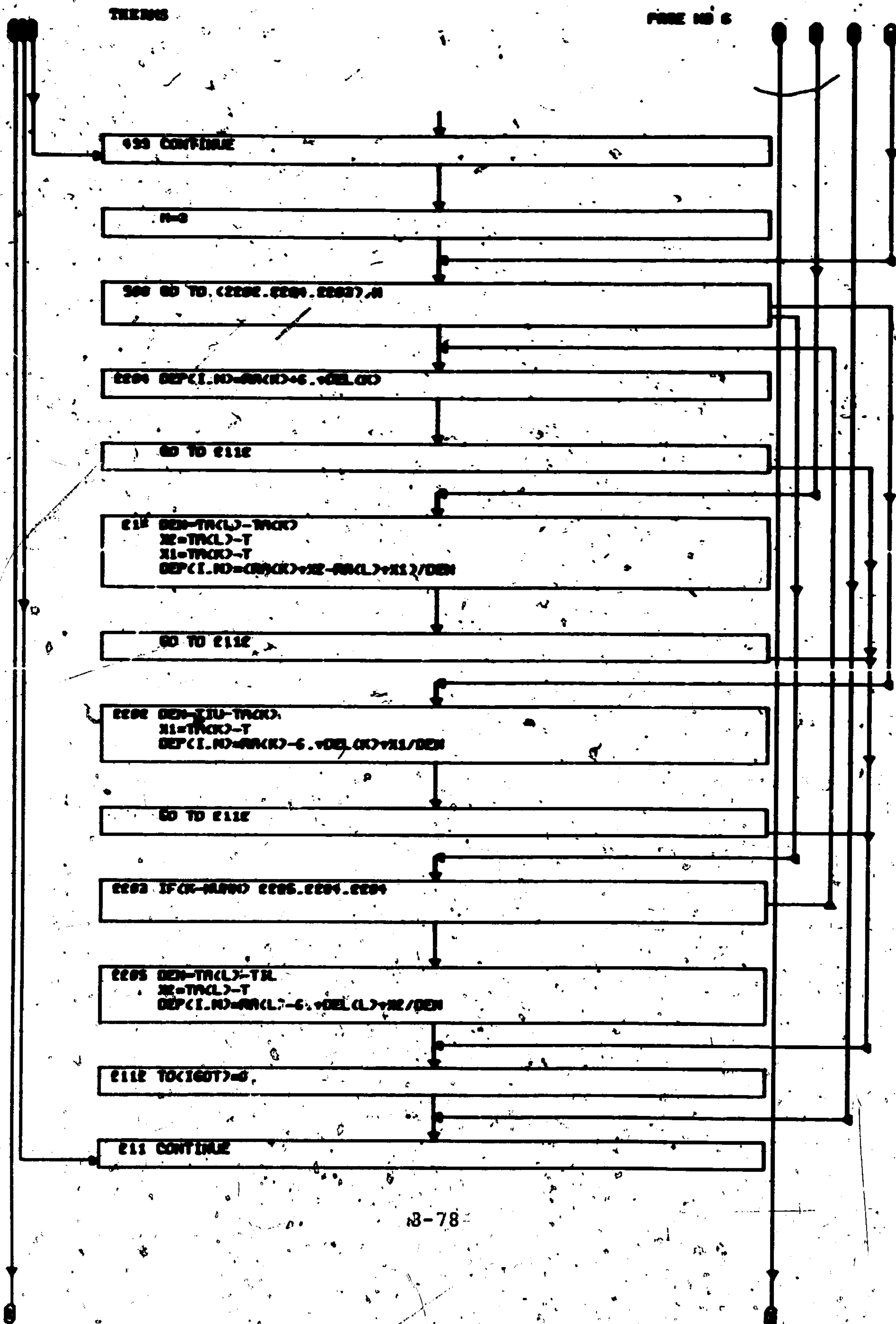

227 K=NL
L=NSM
M=NL
GO TO 223
221 K=NSM+K-2
L=K+1
M=K
223 IF(ABS(1.-GD(I)/(AA(K)+DEL(K)*6.))-1.E-5) 232,232,231
231 IF(ABS(GD(I)/(AA(K)+DEL(K)*6.))-1.) 224,224,225
232 DIS2=AC(K)/2.*CN(K)
224 DIS=(GD(I)-AA(K))/12.
GO TO 226
225 IF(K-NUM)2251,2252,2252
2252 TD(I)=TRES
GO TO 260
2251 DIS=(AA(L)-GD(I))/12.
J=K
K=L
L=J
226 TD(I)=TA(K)+(TA(L)-TA(K))/(0.5*(UNIT(K)+UNIT(L))+AC(M)/AA(M))*
1 DIS/(CN(K)*AA(K))*(1.+DIS2/DIS)
260 CONTINUE

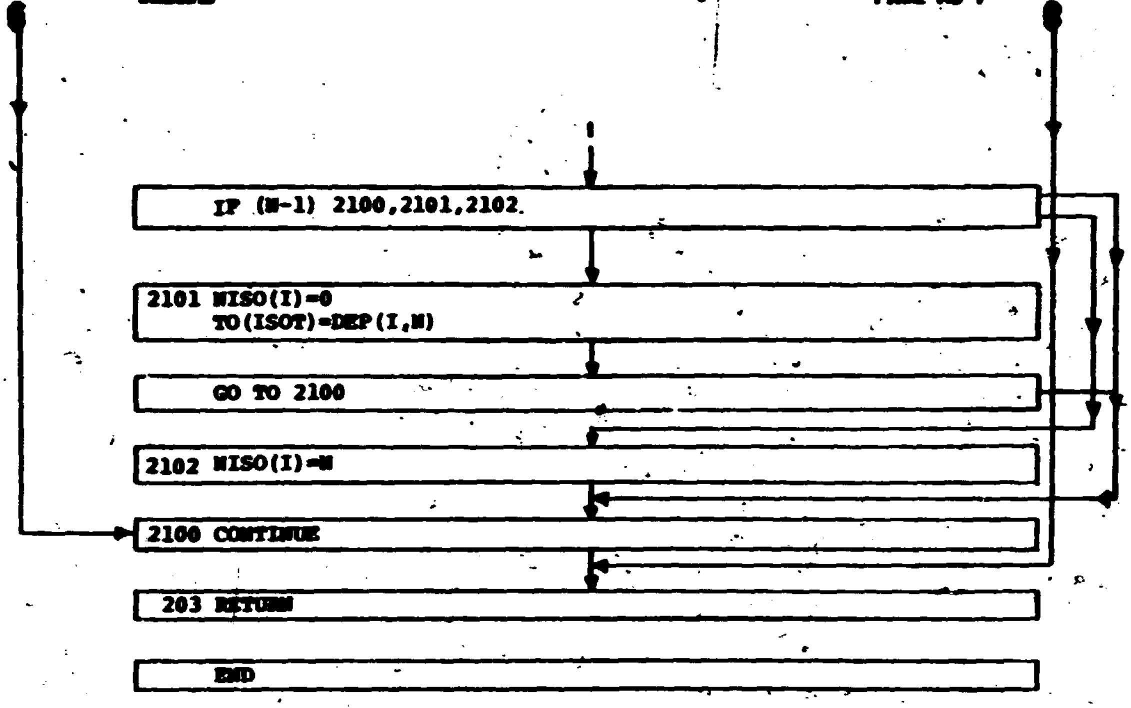

204 DO 210 I=1.NI
NISO(I)=0
DO 210 J=1.5
DEP(I.J)=0.
210 CONTINUE
ISO=ISO+1
DO 2100 I=1.NI
N=0
DO 211 J=1.ISO
IFLG=0
GO TO 102
101 IFLG=1



104 IFLS=IFLS+1
GO TO 105
212 N=N+1
IF(J-1) 211.213.214
GO TO 220


IFLG=0
IWND=0
GO TO (401,402),M
401 T1=TA(K)
T2=TIU
GO TO 403
402 T1=TIU
T2=TIL
403 IF(T-T1) 361,500,362
361 IWND=1
GO TO 363
362 IFLG=1
363 IF(T-T2)367,500,368
367 IWND=IWND+1
GO TO 369
368 IFLG=IFLG+1
369 IF(IFLG+IWND) 500,430,500


433 CONTINUE
N=0
500 GO TO (2202,2204,2203),N
2204 DEP(I,N)=AA(K)+6.*DEL(K)
GO TO 2112
212 DEN=TA(L)-TA(K)
X2=TA(L)-T
X1=TA(K)-T
DEP(I,N)=(AA(K)*X2-AA(L)*X1)/DEN
GO TO 2112
2202 DEN=TIU-TA(K)
X1=TA(K)-T
DEP(I,N)=AA(K)-6.*DEL(K)*X1/DEN
GO TO 2112
2203 IF(K-NUMN) 2205,2204,2204
2205 DEN=TA(L)-TIL
X2=TA(L)-T
DEP(I,N)=AA(L)-6.*DEL(L)*X2/DEN
2112 TO(IGOT)=0.
211 CONTINUE


IF (N-1) 2100,2101,2102
2101 NISO(I)=0
TO(ISOT)=DEP(I,N)
GO TO 2100
2102 NISO(I)=N
2100 CONTINUE
203 RETURN
END

```
      SUBROUTINE LCOUNT (J,LCT,NPG,R)
      COMMON KOUT
      DIMENSION R(2)
  551 FORMAT(1H110X65HAEROTHERM CHARRING MATERIAL THERMAL RESPONSE AND A
     1BLATION PROGRAM/73X4HPAGEI3/1H 67X2A6)
      I=J

      IF(I) 2,2,3

    2 I=-I

      GO TO 4

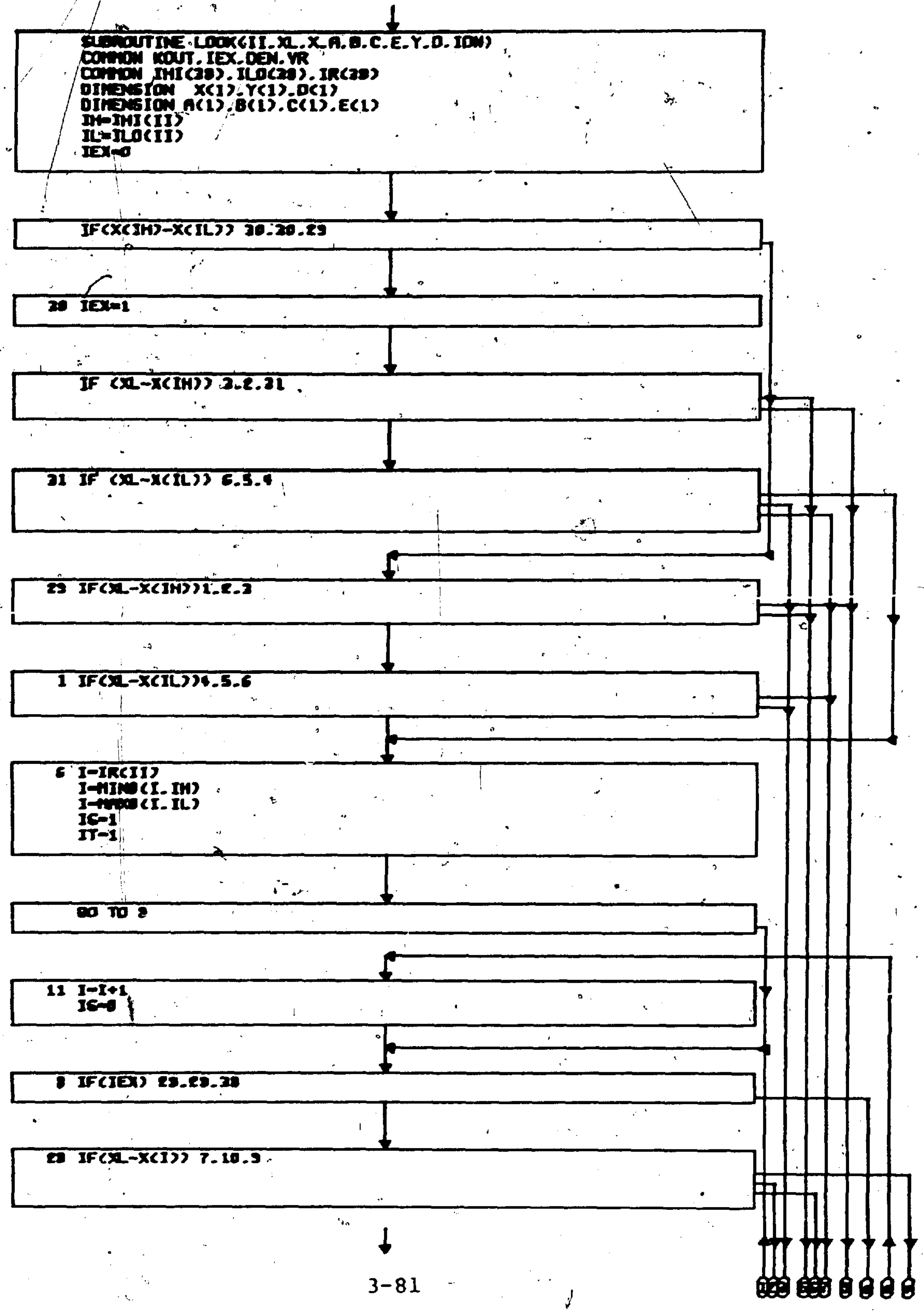
    3 LCT=LCT-I

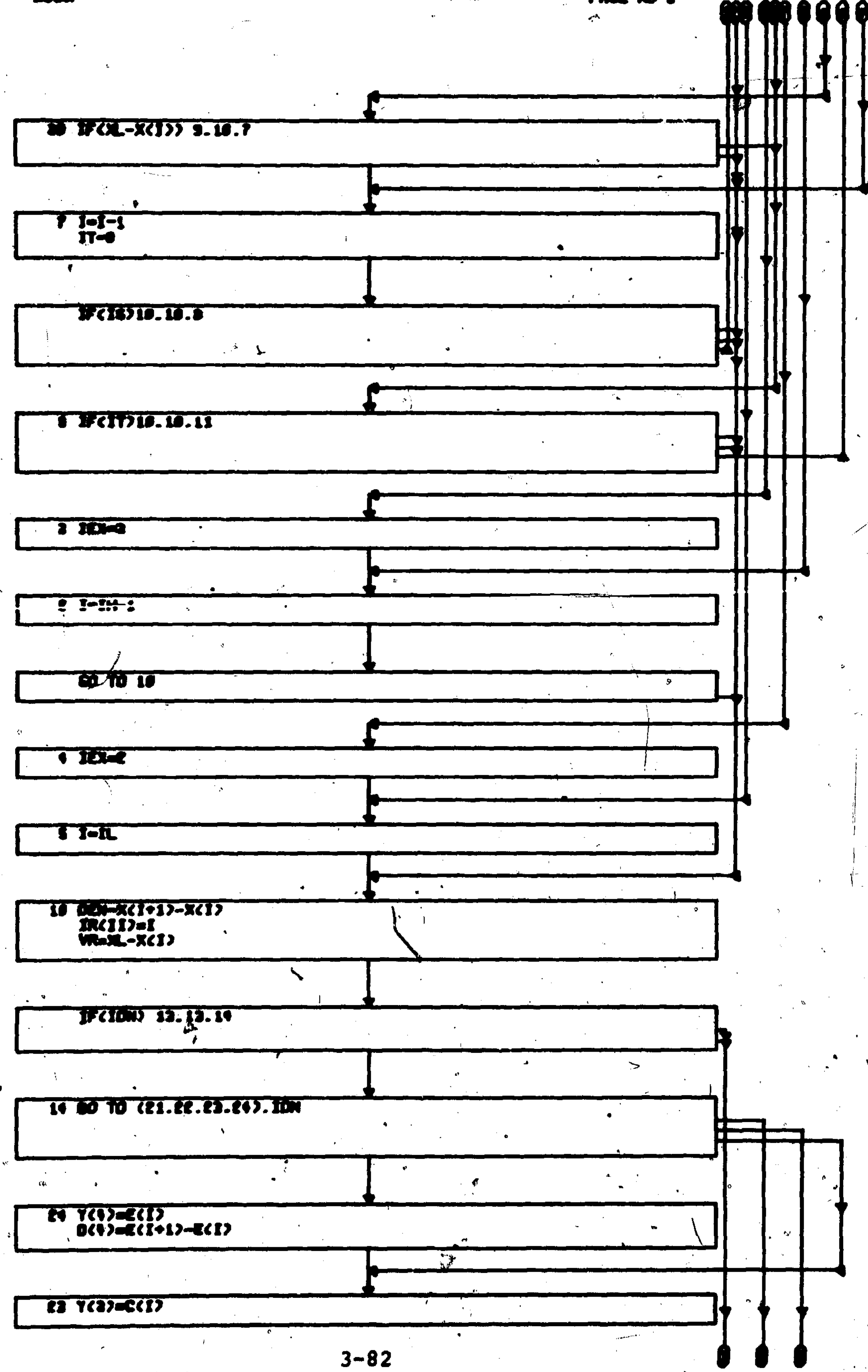
      IF (LCT) 4,5,5

    4 NPG=NPG+1
      LCT=60-I
      WRITE (KOUT,551) NPG,R

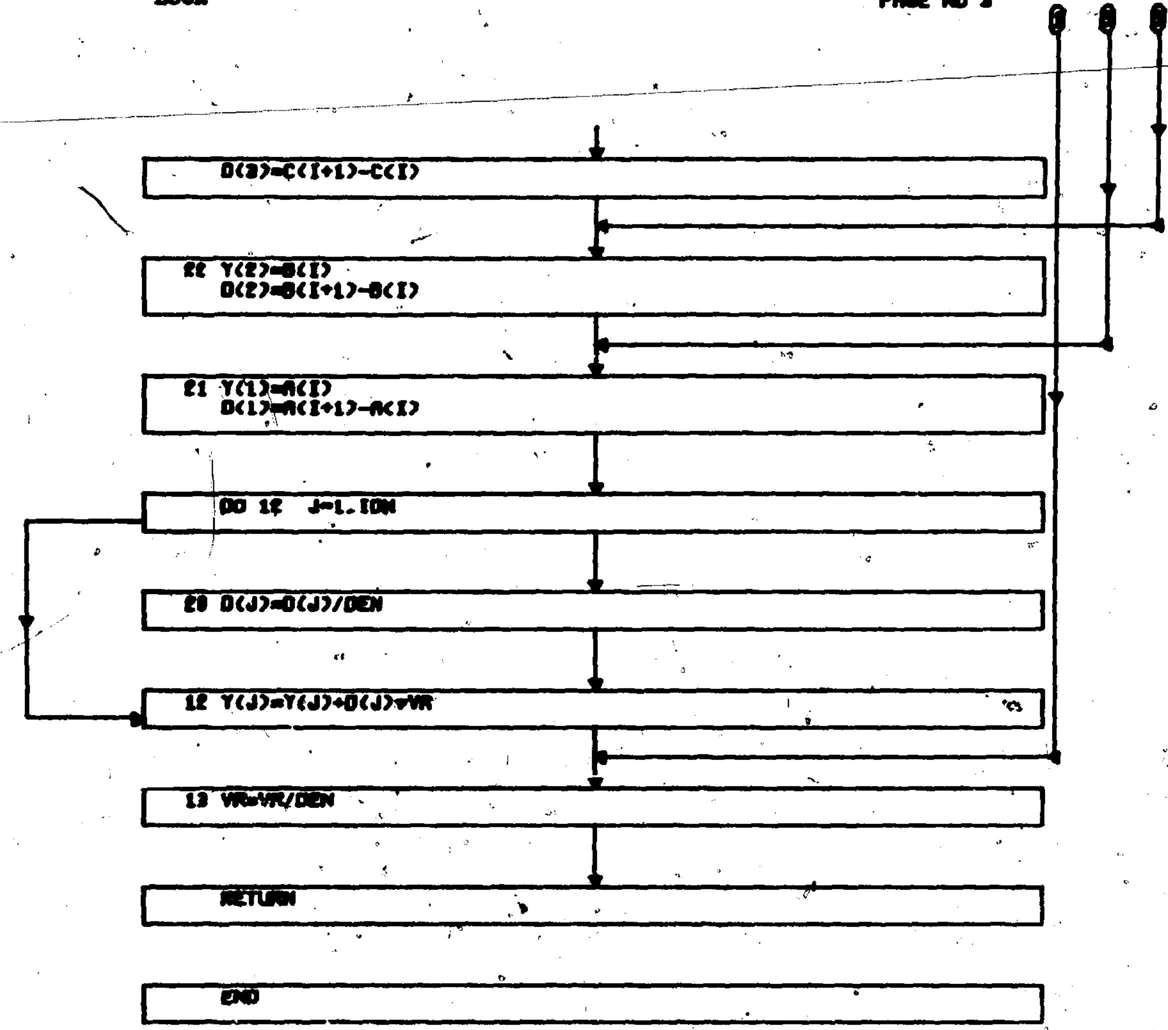
    5 RETURN

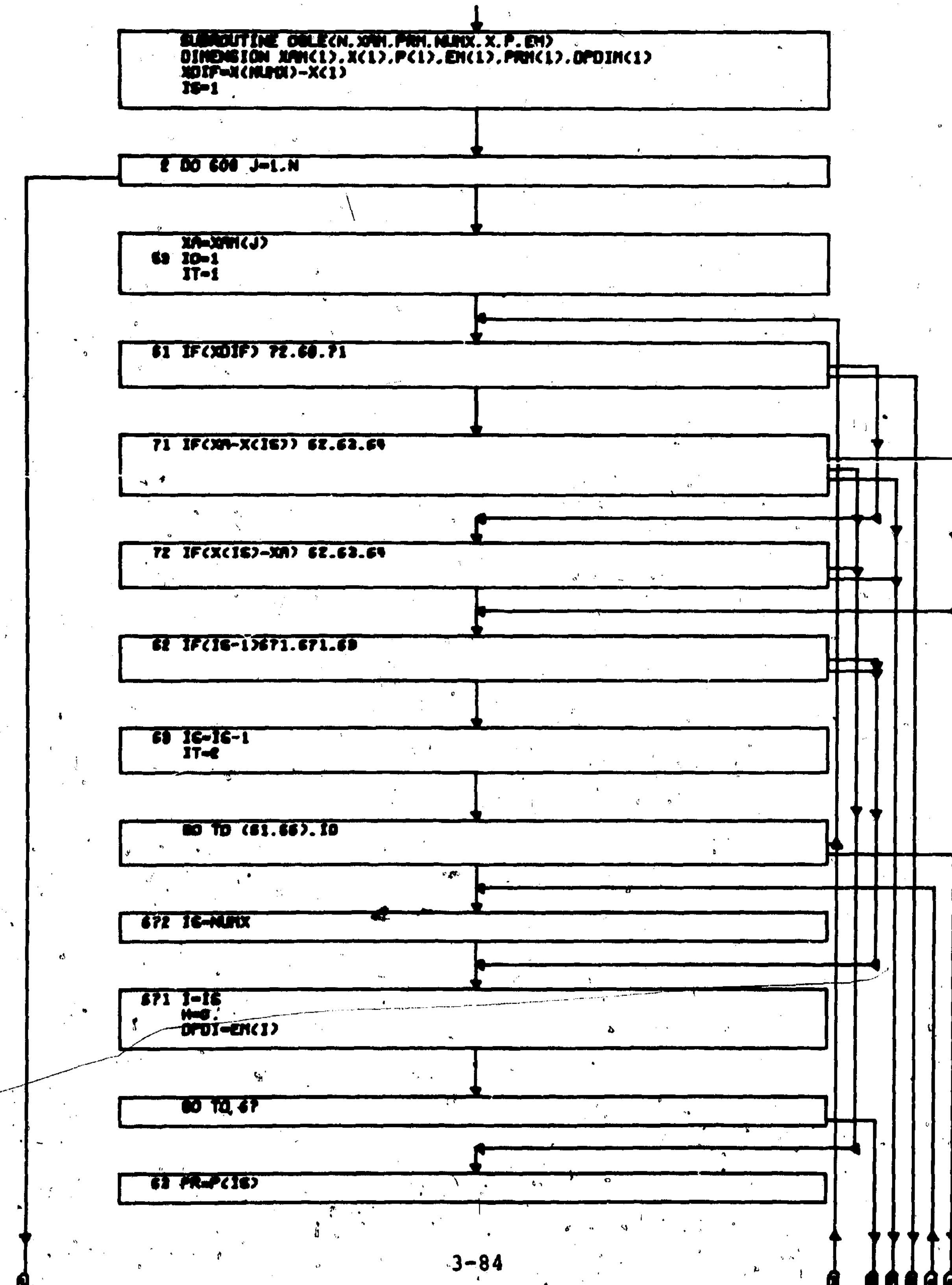
      END
```

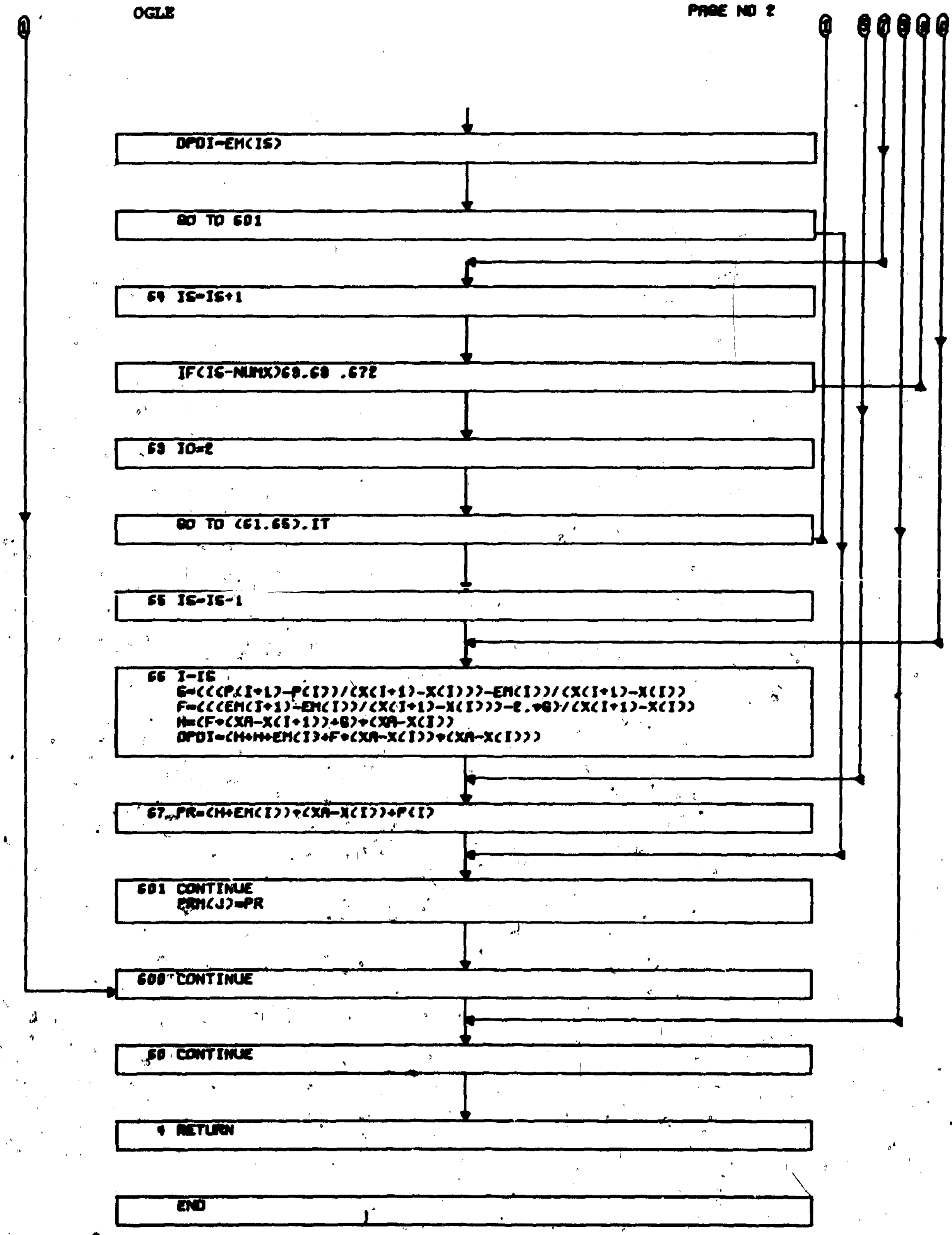

SUBROUTINE LOOK(II.XL.X.A.B.C.E.Y.D.IDW)
COMMON KOUT.IEX.DEN.VR
COMMON IHI(20).ILO(20).IR(20)
DIMENSION X(1).Y(1).D(1)
DIMENSION A(1).B(1).C(1).E(1)
IH=IHI(II)
IL=ILO(II)
IEX=0
IF(X(IH)-X(IL)) 30.20.29
20 IEX=1
IF (XL-X(IH)) 3.2.31
31 IF (XL-X(IL)) 6.5.4
29 IF(XL-X(IH))1.2.3
1 IF(XL-X(IL))4.5.6
6 I=IR(II)
I=MIN0(I.IH)
I=MAX0(I.IL)
IG=1
IT=1
GO TO 8
11 I=I+1
IG=0
8 IF(IEX) 28.28.30
28 IF(XL-X(I)) 7.10.3

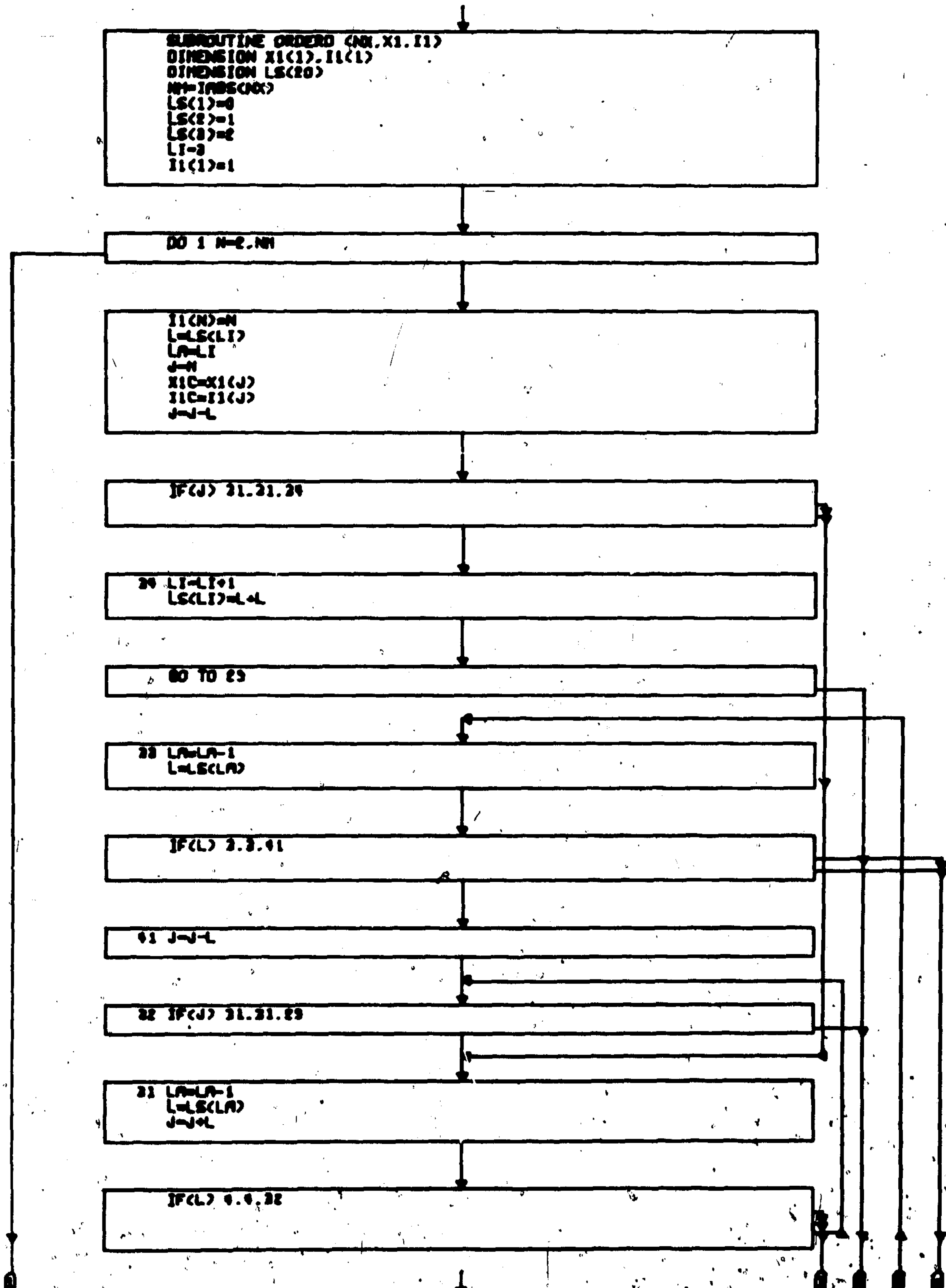


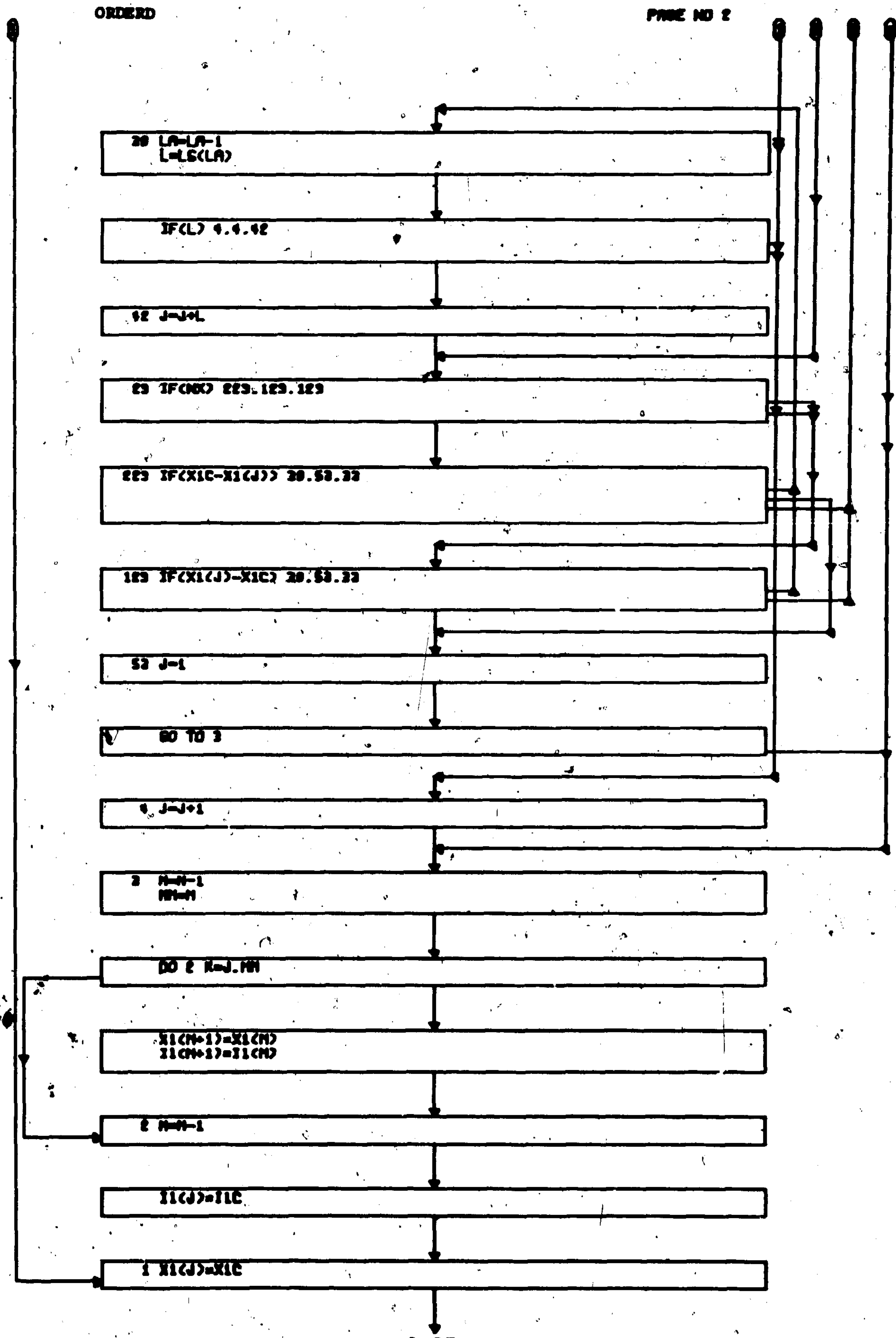
20 IF(XL-X(I)) 9.10.7
7 I=I-1
IT=0
IF(IS)10.10.8
8 IF(IT)10.10.11
3 IEX=0
9 I=I+1
GO TO 10
4 IEX=2
5 I=IL
10 DEN=X(I+1)-X(I)
IR(II)=I
VR=XL-X(I)
IF(IDN) 13.13.14
14 GO TO (21.22.23.24).IDN
24 Y(4)=E(I)
D(4)=E(I+1)-E(I)
23 Y(3)=C(I)


D(3)=C(I+1)-C(I)
22 Y(2)=B(I)
D(2)=B(I+1)-B(I)
21 Y(1)=A(I)
D(1)=A(I+1)-A(I)
DO 12 J=1,IDN
20 D(J)=D(J)/DEN
12 Y(J)=Y(J)+D(J)*VR
13 VR=VR/DEN
RETURN
END


SUBROUTINE OGLE(N,XAM,PRM,NUMX,X,P,EM)
DIMENSION XAM(1),X(1),P(1),EM(1),PRM(1),DPDIM(1)
XDIF=X(NUMX)-X(1)
IG=1
2 DO 600 J=1,N
XA=XAM(J)
69 IO=1
IT=1
61 IF(XDIF) 72,60,71
71 IF(XA-X(IG)) 62,63,64
72 IF(X(IG)-XA) 62,63,64
62 IF(IG-1)671,671,68
68 IG=IG-1
IT=2
GO TO (61,66),IO
672 IG=NUMX
671 I=IG
H=0.
DPDI=EM(I)
GO TO 67
63 PR=P(IG)

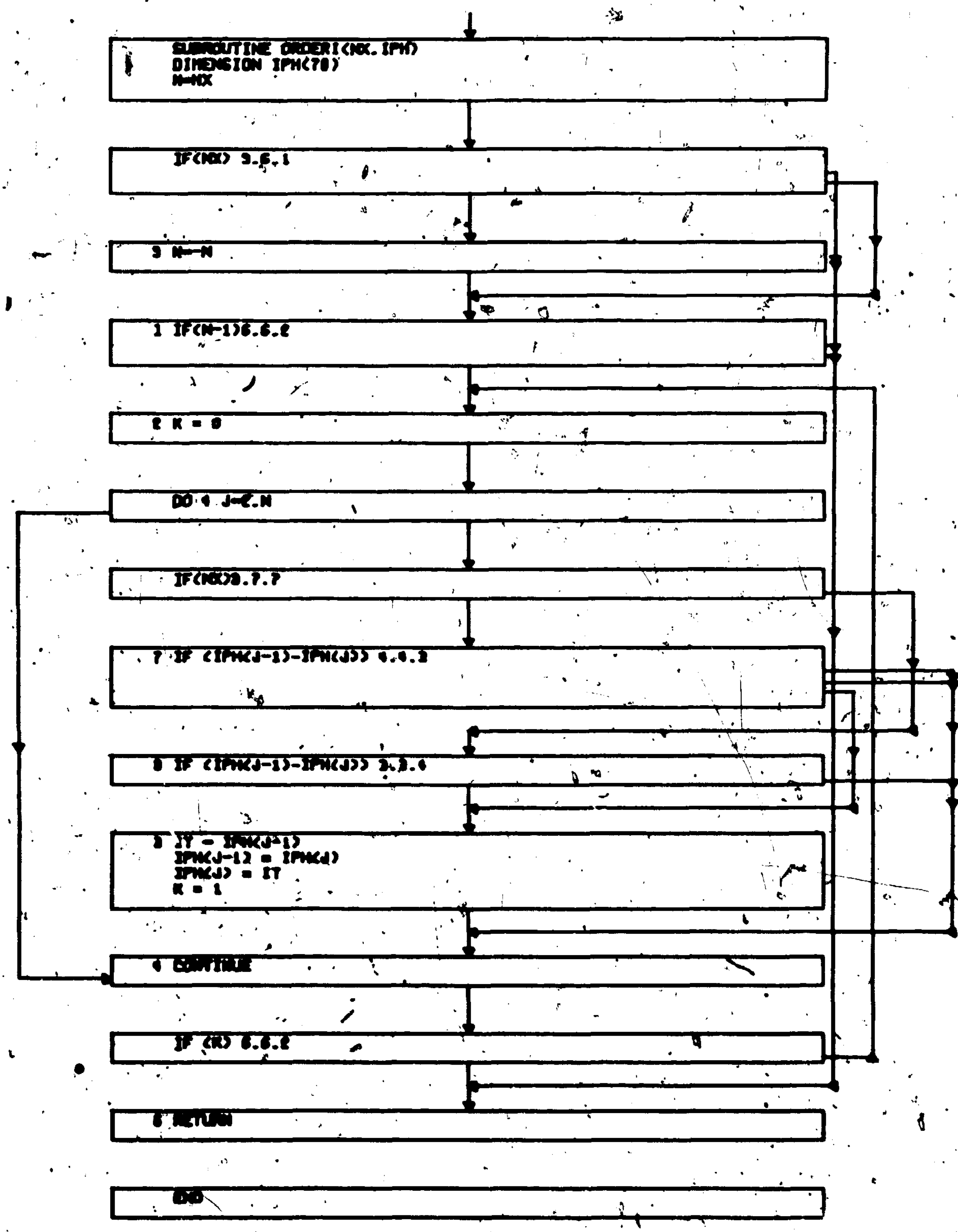

DPDI=EM(IS)
GO TO 601
64 IS=IS+1
IF(IS-NUMX)68.68 .672
68 IO=2
GO TO (61.65).IT
65 IS=IS-1
66 I=IS
G=(((P(I+1)-P(I))/(X(I+1)-X(I)))-EM(I))/(X(I+1)-X(I))
F=(((EM(I+1)-EM(I))/(X(I+1)-X(I)))-2.*G)/(X(I+1)-X(I))
H=(F*(XA-X(I+1))+G)*(XA-X(I))
DPDI=(H+H+EM(I)+F*(XA-X(I))*(XA-X(I)))
67 PR=(H+EM(I))*(XA-X(I))+P(I)
601 CONTINUE
PRM(J)=PR
600 CONTINUE
60 CONTINUE
4 RETURN
END


SUBROUTINE ORDERD (NX,X1,I1)
DIMENSION X1(1),I1(1)
DIMENSION LS(20)
NM=IABS(NX)
LS(1)=0
LS(2)=1
LS(3)=2
LI=3
I1(1)=1
DO 1 N=2,NM
I1(N)=N
L=LS(LI)
LA=LI
J=N
X1C=X1(J)
I1C=I1(J)
J=J-L
IF(J) 21,21,24
24 LI=LI+1
LS(LI)=L+L
GO TO 23
23 LA=LA-1
L=LS(LA)
IF(L) 2,2,41
41 J=J-L
22 IF(J) 31,31,23
31 LA=LA-1
L=LS(LA)
J=J+L
IF(L) 4,4,32

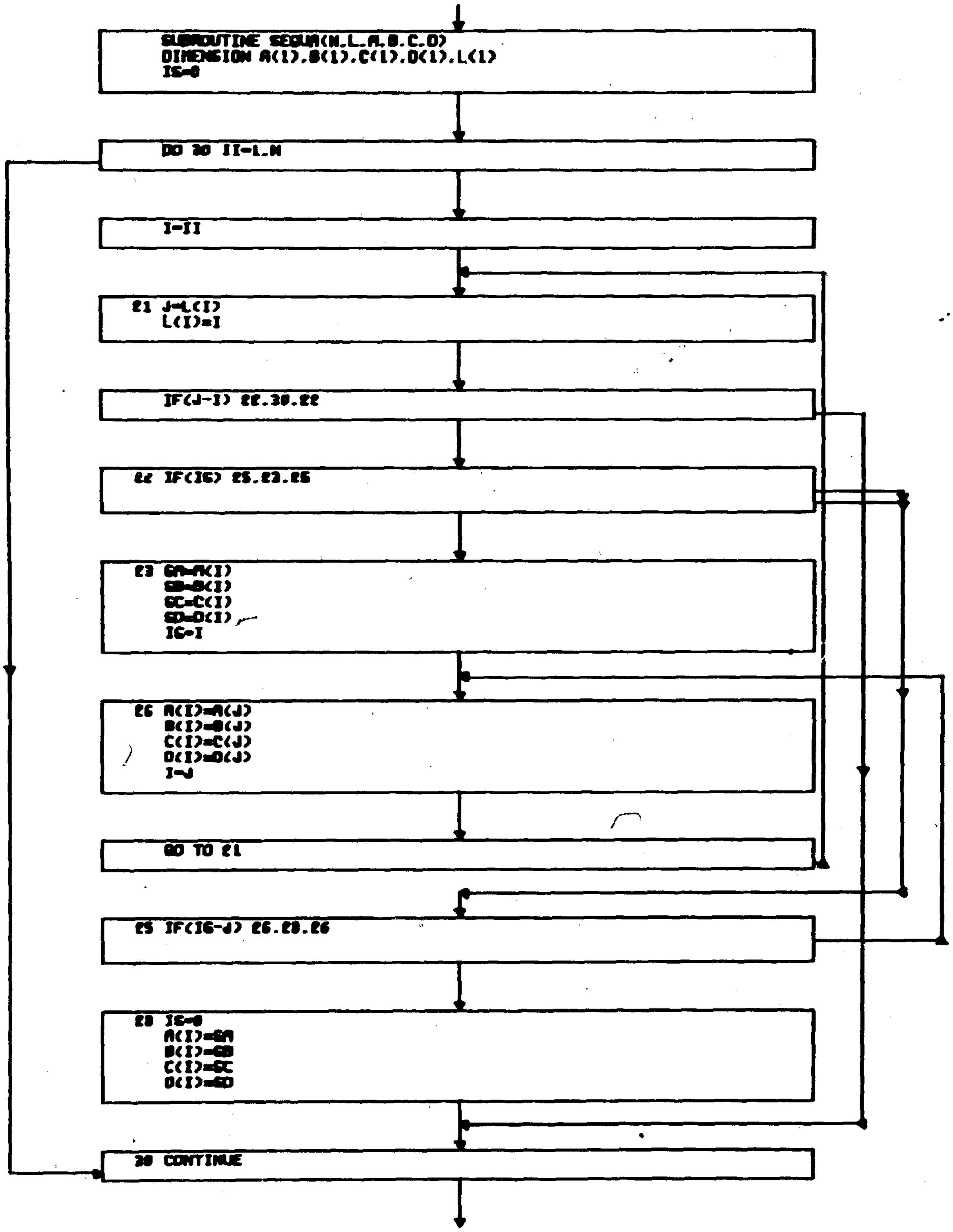

ORDERD
PAGE NO 2
20 LA=LA-1
L=LS(LA)
IF(L) 4.4.42
42 J=J+L
23 IF(NX) 223.123.123
223 IF(X1C-X1(J)) 20.53.33
123 IF(X1(J)-X1C) 20.53.33
53 J=1
GO TO 3
4 J=J+1
3 M=M-1
MM=M
DO 2 K=J.MM
X1(M+1)=X1(M)
I1(M+1)=I1(M)
2 M=M-1
I1(J)=I1C
1 X1(J)=X1C

RETURN

END

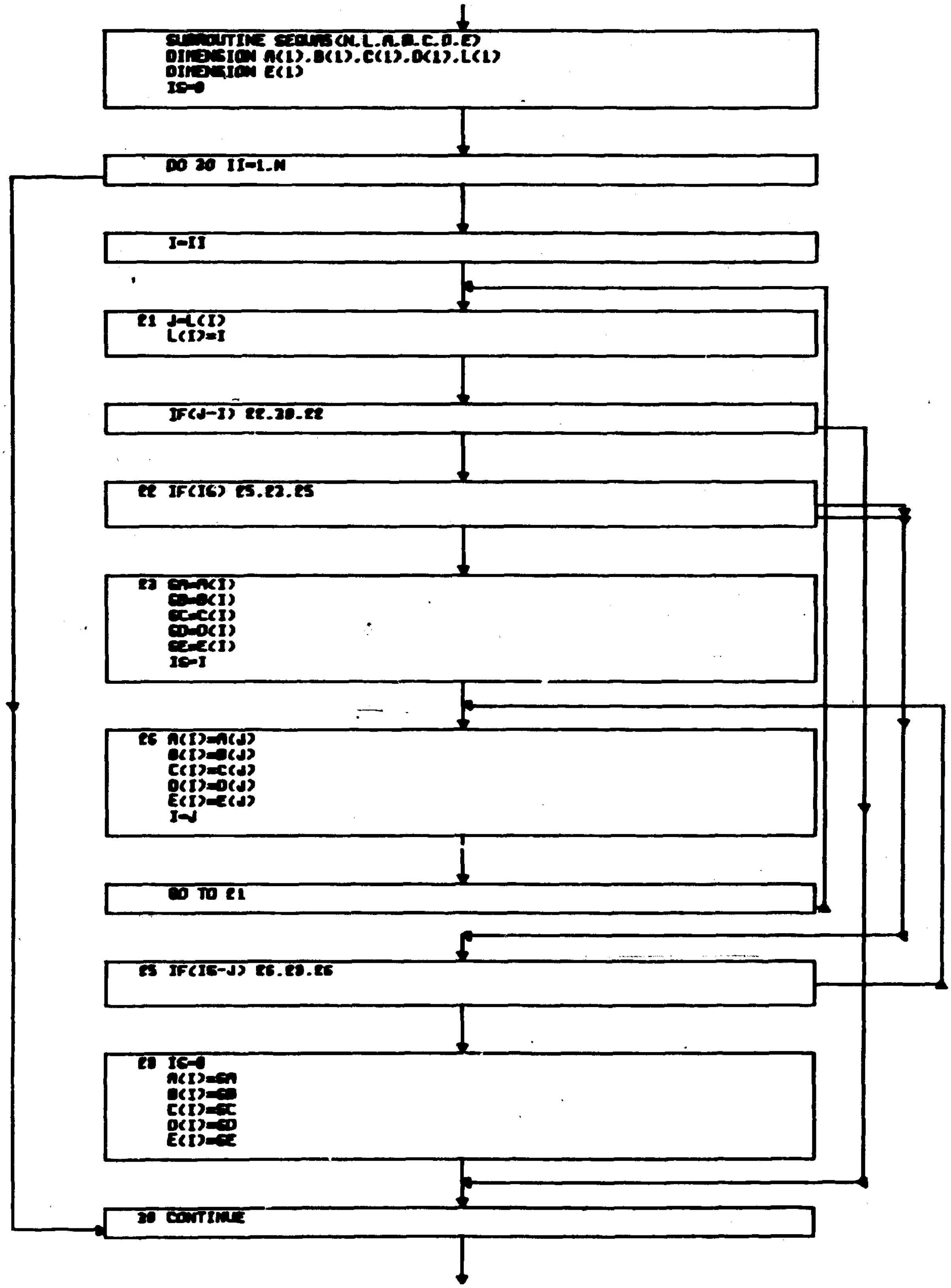


SUBROUTINE ORDERI(NX,IPH)
DIMENSION IPH(70)
N=NX
IF(NX) 3,6,1
3 N=-N
1 IF(N-1)6,6,2
2 K = 0
DO 4 J=2,N
IF(NX)8,7,7
7 IF (IPH(J-1)-IPH(J)) 4,4,5
8 IF (IPH(J-1)-IPH(J)) 5,5,4
5 IT = IPH(J-1)
IPH(J-1) = IPH(J)
IPH(J) = IT
K = 1
4 CONTINUE
IF (K) 6,6,2
6 RETURN
END


SUBROUTINE SEQUA(N.L.A.B.C.D)
DIMENSION A(1).B(1).C(1).D(1).L(1)
IS=0
DO 30 II=1.N
I=II
21 J=L(I)
L(I)=I
IF(J-I) 22.30.22
22 IF(IS) 25.23.25
23 GA=A(I)
GB=B(I)
GC=C(I)
GD=D(I)
IS=I
26 A(I)=A(J)
B(I)=B(J)
C(I)=C(J)
D(I)=D(J)
I=J
GO TO 21
25 IF(IS-J) 26.28.26
28 IS=0
A(I)=GA
B(I)=GB
C(I)=GC
D(I)=GD
30 CONTINUE

RETURN

END


SUBROUTINE SEQUAS(N,L,A,B,C,D,E)
DIMENSION A(1),B(1),C(1),D(1),L(1)
DIMENSION E(1)
IG=0
DO 20 II=1,N
I=II
21 J=L(I)
L(I)=I
IF(J-I) 22,20,22
22 IF(IG) 25,23,25
23 GA=A(I)
GB=B(I)
GC=C(I)
GD=D(I)
GE=E(I)
IG=I
26 A(I)=A(J)
B(I)=B(J)
C(I)=C(J)
D(I)=D(J)
E(I)=E(J)
I=J
GO TO 21
25 IF(IG-J) 26,28,26
28 IG=0
A(I)=GA
B(I)=GB
C(I)=GC
D(I)=GD
E(I)=GE
20 CONTINUE

RETURN

END

```
      SUBROUTINE SLOPQ(NUMX,X,P,EM)
C     SLOPE EVALUATION ROUTINE
C
       DIMENSION X(1), P(1), EM(1), Z(1)
   20 EM(2) = ( P(2) - P(1) ) / ( X(2) - X(1) )
      EM(1) = EM(2)
      Z(1)=0.0
      GC = EM(1)

      DO 26 I = 1 , NUMX

      IPO = I + 1
      IPT = I + 2
      IT = IPO - NUMX

      IF (IT) 23 , 31 , 32

   31 GB=GC

      GO TO 41

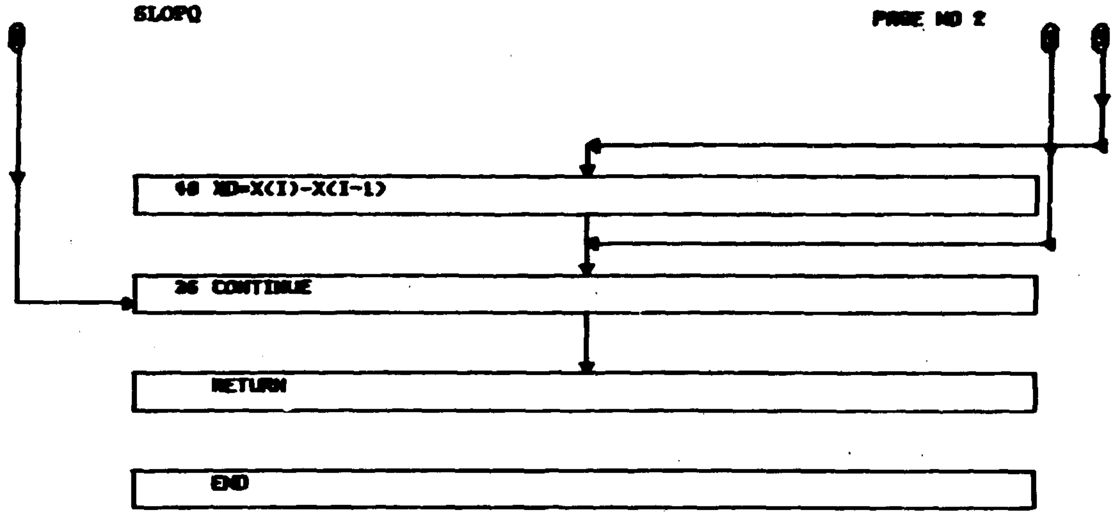
   32 GO TO 40

   23 XOT = X(I) - X(IPO)
      XTT = X(IPO) - X(IPT)
      XTO = X(IPT) - X(I)
      AA = P(I) / ( XOT * XTO )
      XOTT=XOT*XTT
   27 AB=P(I+1)/XOTT
      AC = P(IPT) / ( XTT * XTO )
      AAA = AA * XTT
      ABB = AB * XTO
      ACC = AC * XOT
      GA = GC
      GB = EM(I)
      GC = EM (IPO)
      EM(IPO) = AB * (XOT - XTT) + ACC - AAA
      EM(IPT) = AC * (XTT - XTO) + AAA - ABB
      EM(I)=   AA * (XTO - XOT) + ABB - ACC
   24 GE = EM(I)

      IF(I-2) 26,41,26

   26 EM(I) = ( GE + GA ) /2.

   41 EM(I) = (EM(I) + GB ) /2.
```


40 XD=X(I)-X(I-1)
26 CONTINUE
RETURN
END

SECTION 4

LISTINGS OF FORTRAN IV SOURCE DECKS

Listings of Fortran IV source code decks are presented in this section. A driver routine which allows all computations to be performed by subroutines is presented first. Then the three routines unique to this program CBM, INPØUT, and THERMS are given. Lastly, utility subroutines used by the three main subroutines are listed in alphabetic order.

```
C MAINLINE DUMMY ROUTINE WHICH DRIVES CBM AND INPOUT SUBROUTINES
    1 CALL INPOUT
      CALL CBM
      GO TO 1
      END
```

```
      SUBROUTINE CBM                                                    CBM
C     CHARRING MATERIAL THERMAL RESPONSE AND ABLATION PROGRAM ALLOWING  CBM
C     FOR UP TO FIVE DECOMPOSING BACK-UP MATERIALS                      CBM
C       AEROTHERM CORPORATION     RM KENDALL  C MOYER                   CBM
      COMMON AOUT,ICX,DEN,VR                                            CBM
      COMMON IHI(35),ILO(30),IR(30),TT2(30,10),TCP(30,10),TKP(30,10),THZCBM
     1(30,10),TEP(30,10),TIH(30),THE(30),TQR(30),TCM(30),TT1(30),THG(30)CBM
     2,DH12(2),RECOND(30),SO(20)                                        CBM
      COMMON RHO(10)                                                    CBM
      COMMON MATL( 50),DEL( 51),TA( 51),H(50),RC(50),RA( 50),           CBM
     1AREA( 50),EMA( 50),RAV( 50)                                       CBM
      COMMON ROA( 500),ROB( 500),ROC( 500)                              CBM
      COMMON TPR(3),NMG,IDIOT(2),THG(15,3),NLO(15,3),NHI(15,3),         CBM
     1KHI(15,3),TTSEN(25,3),THSEN(25,3),TCPSEN(25,3),TLMC(25,15,3),     CBM
     2ISEN(3),TPI(30),TTS(25,15,3),TCHEM(25,15,3),VFZ,CMM               CBM
      COMMON TBFF(25,15,3)                                              CBM
      COMMON NPP                                                        CBM
      COMMON LCT,NPG,II,NBM,NUMN,NL,DELMG,DELM,RFT,RHORA,RHORB,RHORC,TRACBM
     1CA,TRACB,TRACC,RHOOA,RHOOB,RHOOC,EA,EB,EC,BA,BB,BC,PSIA,PSIB,PSIC,CBM
     2TRACM,PET,PETE,KSV,ETA,DTPR3,DTPR2,DTPRT,TPR3,TPR2,THZRO,THFIN,WF,CBM
     3THWT,GAMA,OMG,NG,FJFM,FJFS,JF,JFMP,JFM,INPUT,      DTHIN,BRP,MCONV,CBM
     4EPSW,TRES                                                         CBM
      COMMON INCH,DTHG                                                  CBM
      COMMON NN,NI,NOI                                                  CBM
      COMMON CHCRI,PYCRI                                                CBM
      COMMON TBRP(30)                                                   CBM
      COMMON NR                                                         CBM
      COMMON TX(30,6),F1(30,6),F2(30,6)                                 CBM
      COMMON NCON                                                       CBM
      COMMON NBPF,NF1S                                                  CBM
      COMMON BREX,SWELL                                                 CBM
      COMMON BBB(5,3),EE(5,3),FF(5,3),PSI(5,3),RHOO(5,3),RHOR(5,3),     CBM
     1ROCOM(50,3),DHC(5),DHN(5),RHOC(5),RHOV(5),P(5),PP(5),TREF(5),GA(5)CBM
     2,OMGA(5),NFI(5),NLA(5),TTS(30,10),TENT(30,10),TKBU(30,10),TCBU(30,CBM
     310),X(50),NDBU,NBM2                                               CBM
      COMMON TRAC(5,3)                                                  CBM
      COMMON NBUFT(5)                                                   CBM
      COMMON/DATA/ASTER,BLANK                                           CBM
      DIMENSION UROT(3)                                                 CBM
      DIMENSION CNO(50)                                                 CBM
      DIMENSION DNCP(3),CPE(3)                                          CBM
      DIMENSION TO(20)                                                  CBM
      DIMENSION DEP(10,5), NISO(10)                                     CBM
      DIMENSION VITER(51),EITER(51)                                     CBM
      DIMENSION Y2(24),D2(24),Y3(8),D3(8),Y1(2),D1(2)                   CBM
      DIMENSION CPC( 50),CPV( 50),CP( 50),HP ( 50),HC( 50),CN( 50),     CBM
     1RAT(51),ROT(50),RO(50),RON(50),DHDG(50),RR(50),                   CBM
     2CNC( 50),A( 50),B( 50),C( 50),D( 50),EMO( 50)                     CBM
      EQUIVALENCE (DH1,DH12(1)),(DH2,DH12(2)),(TS,TA)                   CBM
  529 FORMAT(17H  ITERATION-STOP  )                                     CBM
  542 FORMAT(/33X14H----OUTPUT----)                                     CBM
  543 FORMAT(//6X28H- - - - - - - - - - - - - - F9.4,37H SECONDS  - - - CBM
     1- - - - - - - - - - - - )                                         CBM
  544 FORMAT(6X,4HTIME,2X,4HSURF,2X,4HPROB,2X,7HSURFACE,5X,6HH WALL,    CBM
     14X,6HH EDGE,6X,10HHEAT COEFF,6X,6HCH/CHO/6X,4HSTEP,2X,4HITER,2X,4HCBM
     2OPTN,2X,8HRAD (IN),3X,8H(BTU/LB),2X,8H(BTU/LB),3X,14H(LB/SQ FT-SECCBM
     3))                                                                CBM
  545 FORMAT(6X,I4,2I6,F10.4,F11.2,F10.2,F12.4,7X,F8.5/1H )             CBM
  546 FORMAT(33X,20H---ABLATION RATES---)                               CBM
  547 FORMAT(8X,7HB PRIME,3X,9HB PRIME G,3X,10HM DOT CHAR,3X,9HM DOT GASCBM
     1,6X,6HM CHAR,7X,5HM GAS/34X,14H(LB/SQ FT-SEC),11X,15H(LB/ORIG SQ FTCBM
     2))                                                                CBM
  548 FORMAT(8X,F8.5,2X,F8.5,4(3X,F10.6)/1H )                           CBM
 5480 FORMAT(27X,32H---RECESSIONS/RECESSION RATES---/                   CBM
     133X,19H(IN)    /    (IN/SEC)/                                     CBM
     2  16X,7HSURFACE,16X,6HCHAR (,F4.2,1H),11X,11HPYROLYSIS (,F4.2,1H))CBM
 5481 FORMAT(5X,3(4X,F10.7,1H/,F9.7)/1H )                               CBM
 5482 FORMAT(27X,31H---SURFACE ENERGY FLUX TERMS---/25X,37HCURRENT RATESCBM
     1 (BTU/SQ FT SURFACE-SEC)/24X,38HAND INTEGRATED VALUES (BTU/ORIG SQCBM
     2 FT)/                                                             CBM
     3     13X,10HCONVECTED ,4X,10H RADIATED ,4X,10H RADIATED ,4X,10H CHECBM
     4MICAL ,4X,10HCONDUCTION/17X,2HIN,12X,2HIN,11X,3HOUT,8X,10HGENERATICBM
     5ON,7X,4HAWAY)                                                     CBM
 5483 FORMAT (6X,4HRATE,3X,5(E10.3,4X)/6X,5HTOTAL,2X,5(E10.3,4X)/1H )   CBM
 5484 FORMAT(30X,27H---INTERIOR ENERGY TERMS---/25X,37HCURRENT RATES (BTCBM
     1U/SQ FT SURFACE-SEC)/24X,38HAND INTEGRATED VALUES (BTU/ORIG SQ FT)CBM
     2/                                                                 CBM
     3         13X,9HPYROL GAS,7X,6HDECOMP,6X,10HCONVECTION,6X,7HSTORAGE, CBM
     47X,7HLOSS AT/14X,7HPICK UP,6X,10HABSORPTION,3X,11HWITH SOLIDS,5X, CBM
     58HIN SOLID,6X,9HREAR FACE)                                        CBM
 5485 FORMAT (6X,4HRATE,3X,5(E10.3,4X)/6X,5HTOTAL,2X,5(E10.3,4X)/1H )   CBM
  549 FORMAT (6X8HNODE MAT3X4HTEMP3X7HDENSITY3X8HENTHALPY2X8HNODE MAT3X4CBM
     1HTEMP3X7HDENSITY3X8HENTHALPY/15X7H(DEG R)11H (LB/CU FT)9H (BTU/LB)CBM
     211X7H(DEG R)11H (LB/CU FT)9H (BTU/LB))                            CBM
 5490 FORMAT(6X,8HNODE MAT,3X,4HTEMP,3X,7HDENSITY,2X,9HCOND(BTU/,2X,8HNOCBM
     1DE MAT,3X,4HTEMP,3X,7HDENSITY,2X,9HCOND(BTU//15X,7H(DEG R),11H (LBCBM
     2/CU FT),9H FT SC F),11X,7H(DEG R),11H (LB/CU FT),9H FT SC F))     CBM
  550 FORMAT (5X2I4,F9.2,F10.3,2XF8.2,1X2I4,F9.2,F10.3,F10.2)           CBM
 5500 FORMAT(5X,2I4,F9.2,F10.3,2X,F8.6,1X,2I4,F9.2,F10.3,F10.6)         CBM
  551 FORMAT(1H110X65HAEROTHERM CHARRING MATERIAL THERMAL RESPONSE AND ACBM
```

```
     1BLATION PROGRAM/73X4HPAGE13/1H 6712A6)
 552 FORMAT(9X,67HOPTIONAL OUTPUT OF THERMOCOUPLE TEMPERATURES AND/OR I
    1ISOTHERM DEPTHS/26X,37HDEPTHS MEASURED FROM ORIGINAL SURFACE/26X,
    231HTEMPERATURES IN DEGREES RANKINE//6X,77HEACH OUTPUT BLOCK SHOWS
    3THE TIME IN SECONDS, THE CURRENT SURFACE TEMPERATURE,/6X,20HTHE TE
    4MPERATURES OF ,I2,44H THERMOCOUPLES, AND THE DEPTHS IN INCHES OF ,
    5I2,10H ISOTHERMS/6X,34HWITHIN THE MAIN ABLATING MATERIAL./)
5521 FORMAT(6X,              70HTHE FIRST BLOCK SHOWS A SAMPLE TIME AND SU
    6RFACE TEMPERATURE, THE SPECIFIED/6X,73HDEPTHS OF THE THERMOCOUPLES
    7 (IF ANY) AND THE ISOTHERM TEMPERATURES.   THE/6X,70HARRANGEMENT O
    8F THIS BLOCK CORRESPONDS TO THE ARRANGEMENT OF THE OUTPUT DATA./)
 553 FORMAT (//6X,11HOUTPUT DATA//)
 554 FORMAT(1X,9F10.4/(20X,8F10.4))
 581 FORMAT(F15.7F10.4/(10X7F10.4))
 582 FORMAT(12E10.3)
C
C
      UNCP(J)=99999.
      KSCT=17
      SIG=.481E-12
C     CHAR AND PYROLYSIS ZONE CRITERIAL DENSITIES
      DNCP(1)=RHO(2)+CHCRI*(RHO(1)-RHO(2))
      DNCP(2)=RHO(2)+PYCRI*(RHO(1)-RHO(2))
C
C     INITIAL VALUES FOR TIME LOOP
C
1390  ITER=-1
      DTHC=DTHB
      IAB=0
      ITS=0
      SA=0.0
      SNET=0.
      GSMT=0.0
      GSM2T=0.
      GSMS=0.
      CMD=0.0
      RSU=ABS(PSV)
      GS=0.0
      CHFX=0.0
      CHT=0.
      DSDIB=0.0
      DSDT=0.
      DSI=0.
      DIDT=0.
      CPE(1)=0.
      CPE(2)=0.
      COLD=0.
      POLD=0.
      DCDT=0.
      DPDT=0.
      QCOND=0.
      QCONV=0.
      QCHEM=0.
      RAD=0.
      QRP=0.
      QCONVT=0.
      QRPT=0.
      RADT=0.
      QCHEMT=0.
      QCONDT=0.
      PGPUT=0.
      DECOMT=0.
      DEDTT=0.
      QLOSST=0.
      TT=0.
      TB=0.
      SOEGR=0.
      GSEGR=0.
      PGPU=0.
      DECOM=0.
      EGO=0.
      HW=0.
      BR=0.
      KK=0
      TH=THZRC
      GTA=0.0
      THDS=THZRO-DTMIN
      THPRI=TH
      REWIND KSCT
      CALL LCOUNT (-2,LCT,NPG,RECORD(35))
      WRITE (KOUT,582)
      IS=0
      DTM=DTMIN
      DELCR=AMIN1(DEL(1),DELM)/5.0
      TSAVE=TA(1)+1.0
      FA=(1.-PSIA)*BA*(RHOOA**(1.-PSIA))
      FB=(1.-PSIB)*BB*(RHOOB**(1.-PSIB))
      FC=(1.-PSIC)*BC*(RHOOC**(1.-PSIC))
      REX=(1.0-.2*BREX)/(1.-BREX)
C
```

```
C     BEGINNING OF TIME LOOP
C
  410 ITER=ITER+1
C
C     CALCULATION OF NODAL PROPERTIES
C
      DO 100 N=2,NL
  100 RA(N-1)=RA(N-1)+DSI
      RA(NL)=RA(NL)+DSI/2.
      CALL UGLE(NL,RA,RR,NUMN,RAV,AREA,EMA)
      ASU=RR(1)
      J=1-JFM-JF
  100 DO 105 N=1,NL
      J=J+JF
      RR(N)=RR(N)/ASU
      CALL LOOK (3,TA(N),TT2,TCP,TKP,THZ,0,Y2,Y2(4),3)
      CN(N)=Y2(2)
      CPV(N)=Y2(1)
      HP(N)=Y2(3)+DH1
      CALL LOOK (4,TA(N),TT2(1,2),TCP(1,2),TKP(1,2),THZ(1,2),0,Y2,D2,3)
      CNC(N)=Y2(2)
      CPC(N)=Y2(1)
      HC(N)=Y2(3)+DH2
      IF (MATL(N)-1) 103,101,102
  101 X(N)=1.
      CP(N)=CPV(N)
      H(N)=HP(N)
      RO(N)=RHO(1)
      ROT(N)=RHO(1)
      GO TO 105
  102 X(N)=0.
      CN(N)=Y2(2)
      H(N)=HC(N)
      CP(N)=CPC(N)
      RO(N)=RHO(2)
      ROT(N)=RHO(2)
      GO TO 105
  103 X(N) = PETE-PET/RO(N)
      H(N)=X(N)*HP(N)+(1.-X(N))*HC(N)
      CP(N)=X(N)*CPV(N)+(1.-X(N))*CPC(N)
      IF(N-1) 109,109,104
  109 ROT(1)=GAMA*(ROA(1)+ROB(1))+OMG*ROC(1)
      GO TO 105
  104 ROT(N)=(ROA(J)+ROB(J))*GAMA+OMG*(ROC(J))
  105 CONTINUE
      IF (ITER) 1050,1050,1051
 1050 RAT(NL)=DEL(NL)/(RR(NL)*(CN(NL)*X(NL)+CNC(NL)*(1.0-X(NL))))
 1051 CONTINUE
      IF (NOBU) 7413,7413,7412
 7412 DO 740  L=1,NOBU
         LL=NFI(L)
         LU=NLA(L)
      N=2*L-1
      DO 741    I=LL,LU
      CALL LOOK(20+2*L,TA(I),TTS(1,N),TCBU(1,N),TKBU(1,N),TENT(1,N)
     C   , 0,Y2,D2,3)
         CN(I)=Y2(2)
         CPV(I)=Y2(1)
         HP(I)=Y2(3)+DHV(L)
      CALL LOOK(21+2*L, TA(I), TTS(1,2*L), TCBU(1,2*L), TKBU(1,2*L),
     C    TENT(1,2*L), 0,Y2,D2,3)
         CNC(I)=Y2(2)
         CPC(I)=Y2(1)
         HC(I)=Y2(3)+DHC(L)
         H(I)=X(I)*HP(I)+(1.0-X(I))*HC(I)
         RR(I)=AREA(I)/ASU
      IF(ITER) 741,7411,741
 7411 RO(I)=X(I)*RHOV(L)+(1.0-X(I))*RHOC(L)
      RON(I)=RO(I)
      RAT(I)= DEL(I)/(RR(I)*(CN(I)*X(I) + CNC(I)*(1.0 -X(I))))
  741    CP(I)=X(I)*CPV(I)+(1.0-X(I))*CPC(I)
  740 CONTINUE
 7413 IF(NUMN-NBM2) 112,106,106
  106 DO 107 N=NBM2,NUMN
      RR(N)=AREA(N)/ASU
      KT=MATL(N)
      CALL LOOK(KT+2,TA(N),TT2(1,KT),TCP(1,KT),TKP(1,KT),0,0,Y2,D2,2)
      CP(N)=Y2(1)
      CN(N)=Y2(2)
      RAT(N)=DEL(N)/(CN(N)*RR(N))
  107 RO(N)=RHO(KT)
  112 HRES=SIG*EPSW*(TA(NUMN)+TRES)*(TA(NUMN)**2+TRES**2)+HCONV
      RAT(NUMN+1)=1./(HRES*RR(NUMN)+.00000001)
      QLOSS=(TA(NL)-TA(NBM))/(0.5*(RAT(NL)+RAT(NBM))+RC(NL)/RR(NL))
      QLOSST=QLOSST+QLOSS*DTH/AREA(1)*ASU
      CMT=CMT+RHO(2)*DSDT*ASU/AREA(1)*DTH
      DEL(NUMN + 1) = CN(NUMN)/(HRES + 0.00000001)
      RR(NUMN+1)=RR(NUMN)
      DTHS=DTH
      DTS=TSAVE-TA(1)
```

```
      IF(ITER) 151,606,151
C
C     OUTPUT
C
  151 CALL SSWTCH(4,KKSW)
      GO TO (3000,750),KKSW
  750 IF (TM-THPRT+.00001) 4410,3000,3000
 3000 DIDT=12.0*USDTB
      NDR=NUM-NL-1
      NLI=(NUMN-NDR+1)/2
      K=NLI
      CALL LCOUNT(33+NLI,LCT,NP6,NECORD(35))
  322 WRITE (KOUT,543)TM
      WRITE (KOUT,544)
      WRITE (KOUT,545) ITER,ITS,II    ,RSU,NW,HE,CH,BR
      WRITE (KOUT,546)
      WRITE (KOUT,547)
      WPRM=(GS  +CND)/(CH*CNM)
      WPRMG=GS  /(CH*CNM)
      WRITE (KOUT,548) BPRM,BPRMG,CND,GSMS,CNT,GSMT
      WRITE (KOUT,5480) CMCRI,PYCRI
      WRITE (KOUT,5481) SA,DIDT,CPE(1),DCDT,CPE(2),DPDT
      WRITE (KOUT,5482)
 3224 WRITE (KOUT,5483) QCONV,QRP,RAD,QCHEM,QCOND,QCONVT,QRPT,RADT,QCHEM
     1T,QCONDT
      WRITE (KOUT,5484)
      WRITE (KOUT,5485)PGPU,DECON, TB,DEDT,QLOSS,PGPUT,DECONT, TT,DEDTT,
     1QLOSST
      IF (NCON) 3020,3020,3021
 3021 WRITE(KOUT,5490)
      GO TO 3022
 3020 WRITE(KOUT,549)
 3022 CONTINUE
      IF(NOI) 190,190,183
  183 CALL SLOPQ (NL,WA(1),TA(1),EMO(1))
      IF(NO) 182,182,184
  184 CALL OGLE (NO,SO,TO(1),NL,RA(1),TA(1),EMO(1))
  182 IF (NI) 189,189,185
  185 DO 186 I=1,NL
  186 EMO(I)=1./EMO(I)
      CALL OGLE (NI,SO(NO+1),TO(NO+1),NL,TA,RA,EMO)
  189 IF(NUMN-NBM)800,801,801
  801 CALL THERMS(NISO,TO,DEP,RR,CN,RAT)
  800 IF(NN) 188,188,187
  187 DO 1873 I=1,NOI
      IF(I-NO) 1870,1870,1871
 1870 PUNCH 581,I, TM, SO(I), TO(I)
      GO TO 1873
 1871 IF(NUMN-NBM) 1870,1874,1874
 1874 KI=I-NO
      IF(NISO(KI)-1) 1870,1870,1872
 1872 PUNCH 581,I,TM,SO(I),(DEP(KI,J),J=1,N)
 1873 CONTINUE
  188 WRITE(KSCT) TM,TS,TO,DEP,NISO
      KK=KK+1
  190 CONTINUE
      M=MT
      IF (NCON) 3012,3012,3006
 3006 DO 3009 I=1,NL
      IF (WT) 3007,3007,3008
 3008 CALL LOOK(31+M,AA(I),TX(1,M),F1(1,M),F2(1,M),0,0,Y1,D1,2)
      CNO(I)=Y1(1)*CN(I)+Y1(2)*CNC(I)
      GO TO 3009
 3007 CNO(I)=X(I)*CN(I)+(1.0-X(I))*CNC(I)
 3009 CONTINUE
      IF(NDBU) 3023,3023,3024
 3024 DO 3030 I=1,NDBU
      LL=NFI(I)
      LU=NLA(I)
      L=NBUFT(I)
      DO 3025 J=LL,LU
      IF(L) 3026,3026,3027
 3027 CALL LOOK(31+L,X(J),TX(1,L),F1(1,L),F2(1,L),0,0,Y1,D1,2)
      CNO(J)=Y1(1)*CN(J)+Y1(2)*CNC(J)
      GO TO 3025
 3026 CNO(J)=X(J)*CN(J)+(1.0-X(J))*CNC(J)
 3025 CONTINUE
 3030 CONTINUE
 3023 IF(NUMN-NBM2) 3012,3028,3028
 3028 DO 3029 I=NBM2,NUMN
 3029 CNO(I)=CN(I)
 3012 CONTINUE
      DO 3011 J=1,NLI
      L=J
      IF (L-NL) 3002,3002,3001
 3001 L=L+NDR
      K=NLI
      GO TO 3003
 3002 IF (L+NLI-NL) 3003,3003,3005
 3005 K=NLI+NDR
```

```
3003 N=MIN0(NUMN,K+L)
     IF (NCON) 3004,3004,3010
3004 WRITE (KOUT,550) (I,MATL(I),TA(I),RO(I),M(I), I=L,N,K)
     GO TO 3011
3010 WRITE(KOUT,5500)(I,MATL(I),TA(I),RO(I),CNO(I),I=L,N,K)
3011 CONTINUE
     IF(SWELL) 3100,3101,3100
3100 SDNET=(1.+SWELL)*DIDT-SWELL*DCDT
     WRITE(KOUT,590) SNET,SDNET
 590 FORMAT(/10X,40HSURFACE RECESSION AFTER SWELL (INCHES)         = F8
    1.4/10X,40HSURFACE RECESSION RATE WITH SWELL (INCHES/SEC) =F8.4)
3101 CONTINUE
     CALL SSWTCH(3,KKSW)
     GO TO (745,746),KKSW
 745 IF(NDBU) 746,746,747
 747 LU=NBM2-1
     L=LU-NBM+1
     L=L+L/6+2
     CALL LCOUNT(L,LCT,NPG,RECORD(35))
     DO 748 I=NBM,LU
 748 WRITE(KOUT,749)(ROCON(I,J),J=1,3)
     WRITE (KOUT,749) (DNDG(J),J=NBM,LU)
     WRITE(KOUT,749) GSMS,GSM2S,GS,GSM2T,GSM
     LU=NUMN-NDR
     WRITE(KOUT,7490) (A(K),B(K),C(K),D(K),K=1,LU)
 749 FORMAT (10X,6E10.3)
7490 FORMAT(10X,4E10.3)
 746 CONTINUE
3225 IF(TH-THFIN+0.00001)1151,2    ,2
   2 IF (NUI) 1,1,3
   3 REWIND KSCT
     N=0
     CALL LCOUNT(-10,LCT,NPG,RECORD(35))
     WRITE(KOUT,552)  NO,NI
     WRITE(KOUT,5521)
     WRITE(KOUT,554) TH,TS,(SO(I),I=1,NOI)
     WRITE (KOUT,553)
     DO 4 K=1,KK
     READ(KSCT) TH,TS,TO,DEP,NISO
     DO 805 I=1,NI
     IF(N-NISO(I)) 806,805,805
 806 N=NISO(I)
 805 CONTINUE
     CALL LCOUNT( 1 ,LCT,NPG,RECORD(35))
   4 WRITE (KOUT,554) TH,TS, (TO(I), I=1,NOI)
     IF(NUMN-NBM) 1,802,802
 802 IF(NI*N) 1,1,803
 803 REWIND KSCT
     CALL LCOUNT(-7,LCT,NPG,RECORD(35))
     WRITE(KOUT,560)
     J=NO+1
     WRITE(KOUT,7041) (SO(I),I=J,NOI)
     WRITE(KOUT,7042)
 560 FORMAT(/6X66HTHE FOLLOWING BLOCK GIVES THE OUTPUT TIME AND UP TO F
    1IVE LOCATIONS / 6X,55HOF THE INDICATED ISOTHERMS WITHIN THE BACKUP
    2 MATERIALS.)
7041 FORMAT(//12X,9(2X,F10.4))
7042 FORMAT(/)
     DO 804 K=1,KK
     READ(KSCT)TH,TS,TO,DEP,NISO
     DO 804 J=1,N
     CALL LCOUNT( 1,LCT,NPG,RECORD(35))
 804 WRITE(KOUT,554) TH,(DEP(I,J),I=1,NI)
     GO TO 1
1151 IF(TH-TPR2+0.00001)  154,158,158
 158 DTPRT=DTPR2
     DTPR2=DTPR3
     TPR2=TPR3
     TPR3=THFIN
 154 CONTINUE
     IF(TH-THPRT+.00001) 743,742,742
 742 THPRT=AMIN1(THPRT+DTPRT,TPR2)
 743 CONTINUE
4410 DTH=AMIN1(DTH0,DELCR/(DSDTB+.0000001),TH-THOS, 50.0/(ABS(TSAVE-TA(
    11))+.1)*DTH)
     TSAVE=TA(1)
     DTH=(THPRT-TH)/(AINT((THPRT-TH)/DTH+1.0))
 144 TH=TH+DTH
C
C    FUNCTIONS OF TIME
 606 I=IR(1)
     VF=VFZ
 601 IF(TTM(I+1)-TH+0.00001) 614,604,604
 614 IF(I+1-INT(1)) 602,604,604
 602 I=I+1
     IF(TTM(I+1)-TTM(I)) 601,603,601
 603 TH=TH-DTH
     THOS=TTM(I)-DTMIN
     DTH=AMAX1(DTMIN,TTM(I)-TH)
     TH=TH+DTH
```

```
      GO TO 601
  604 DEN=(TM-TTM(I))/(TTM(I+1)-TTM(I))
      IF (TTM(I+1)-TTM(I)) 6040,6040,605
 6040 DEN=0.
  605 CM=TCM(I)+DEN*(TCM(I+1)-TCM(I))
      QRA=TQR(I)+DEN*(TQR(I+1)-TQR(I))
      PRES=TPI(I)+DEN*(TPI(I+1)-TPI(I))
      ME=TME(I)+DEN*(TME(I+1)-TME(I))
      BRP=TBRP(I)+DEN*(TBRP(I+1)-TBRP(I))
      II=1
      IF(CM) 6001,6001,600
 6001 II=2
      CM=0.0
      IF (ME-2.) 6002,6002,600
 6002 II=3
      VF=ME
      ME=0.
  600 IR(1)=1
      IF(ITER) 610,113,610
  113 DEDT=0.
      ITER=1
      GO TO 3000
  610 IF(DTM-.000001) 162,162,608
  162 WRITE (KOUT,502) TM,DTM,DTMS,DTMB,TMDS,DTS,DELCR,DSDTB
      TM=TMFIN
      GO TO 3000
C
C     INTERNAL DECOMPOSITION  --  DENSITY CALCULATION
  608 N=-JFM
C
C     SPECIFY SURFACE CHANGES DURING THIS TIME INTERVAL
      DSDT=DSDTB
      DS=DSDT*DTM
      DSI=12.0*DS
      SA=SA+DSI
      RSU=ABS(RSV+SA)
      DTMB=DTMC
      DEL(NL)=DEL(NL)-DS
      FV=0.0
      FJF=FJFM
      J1=JFMP
      DENOLD=RHO(2)
      COLD=CPE(1)
      POLD=CPE(2)
      CPE(1)=RA(NL)+6.*DEL(NL)
      CPE(2)=CPE(1)
      IE=1
      ROOZ=0.0
      ISV=MATL(NL+1)
      MATL(NL+1)=MATL(NL)
      TA(NL+1)=TA(NBM)
      DEL(NL+1)=DEL(NBM)
      RR(NL+1)=RR(NBM)
      DO 252 I=1,NL
      DMDG(I)=0.0
      RON(I)=ROOZ
      DSS=FJF/DEL(I)*DSDT
  463 DO 255 J=J1,JF
      N=N+J1-1
      IF (J-JFMP) 253,259,253
  259 IF (MATL(I)+MATL(I+1)-4) 263,260,263
  263 IF(AMAX1(TA(I),TA(I+1))-TRACM)261,261,262
  261 IF (MATL(I)+MATL(I)+MATL(I+1)-3) 262,260,262
  260 J1=JFMP
      ROOZ=FJFM*RO(I+1)
      RON(I)=RON(I)+FJFM*RO(I)
      N=N+JFM
      GO TO 264
  262 ROOZ=0.0
      DTA=(TA(I+1)-TA(I))/(FJFS-FJF/DEL(I)*DEL(I+1)/RR(I)*RR(I+1))
      J1=1
      TAS=TA(I)
  253 N=N+1
      IF(ABS(DSS)-.000001) 1016,1016,1017
 1016 DROAC=0.
      DROBC=0.
      DROCC=0.
      GO TO 1021
 1017 IF(I-NL) 1015,1018,1015
 1018 FK=FK-1.0
      IF(FK) 1019,1016,1020
 1019 FK=FJF-1.0
 1020 DSS=DSDT/DEL(I)*FK
 1015 IF (N-1) 1115,1215,1115
 1115 DROAC=(ROA(N+1)-ROA(N))*DSS
      DROBC=(ROB(N+1)-ROB(N))*DSS
      DROCC=(ROC(N+1)-ROC(N))*DSS
      GO TO 1021
 1215 IF(II-1) 1115,1315,1115
 1315 DROAC=(ROA(N+1)-RHORA)*DSS
```

```
      DROBC=(ROB(N+1)-RHORB)*DSS
      DROCC=(ROC(N+1)-RHORC)*DSS
      ROT(1)=RHO(2)
 1021 TAS=TAS+DTA
      IF(TAS-TRACM) 227,227,229
  229 IF(TAS  -TRACA) 201,201,202
  201 DROAT=0.0
      GO TO 2113
  202 IF(RHORA-ROA(N)) 211,201,201
  211 RD=ROA(N)-RHORA
      POW=1.-PSIA
      IF(POW)2111,2112,2111
 2111 DROAT=(-RD+((RD**POW)-                           FA*EXP(-EA/TAS)*DTH)**
     1(1./POW))/DTH
      GO TO 2113
 2112 DROAT=RD*(EXP(-BA*DTH*EXP(-EA/TAS))-1.)/DTH
 2113 ROA(N)=ROA(N)+(DROAT+DROAC)*DTH
      IF(ROA(N)-RHORA) 2114,221,221
 2114 ROA(N)=ROA(N)-(DROAT+DROAC)*DTH
      DROAT=(RHORA-ROA(N))/DTH-DROAC
      ROA(N)=RHORA
  221 IF(TAS  -TRACB)203,203,204
  203 DROBT=0.0
      GO TO 2133
  204 IF(RHORB-ROB(N))213,203,203
  213 RD=ROB(N)-RHORB
      POW=1.-PSIB
      IF(POW)2131,2132,2131
 2131 DROBT=(-RD+((RD**POW)-                           FB*EXP(-EB/TAS)*DTH)**
     1(1./POW))/DTH
      GO TO 2133
 2132 DROBT=RD*(EXP(-BB*DTH*EXP(-EB/TAS))-1.)/DTH
 2133 ROB(N)=ROB(N)+(DROBT+DROBC)*DTH
      IF(ROB(N)-RHORB) 2134,223,223
 2134 ROB(N)=ROB(N)-(DROBT+DROBC)*DTH
      DROBT=(RHORB-ROB(N))/DTH-DROBC
      ROB(N)=RHORB
  223 IF(TAS  -TRACC) 205,205,206
  205 DROCT=0.0
      GO TO 2153
  206 IF(RHORC-ROC(N))215,205,205
  215 RD=ROC(N)-RHORC
      POW=1.-PSIC
      IF (POW) 2151,2152,2151
 2151 DROCT=(-RD+((RD**POW)-                           FC*EXP(-EC/TAS)*DTH)**
     1(1./POW))/DTH
      GO TO 2153
 2152 DROCT=RD*(EXP(-BC*DTH*EXP(-EC/TAS))-1.)/DTH
 2153 ROC(N)=ROC(N)+(DROCT+DROCC)*DTH
      IF(ROC(N)-RHORC) 2154,225,225
 2154 ROC(N)=ROC(N)-(DROCT+DROCC)*DTH
      DROCT=(RHORC-ROC(N))/DTH-DROCC
      ROC(N)=RHORC
  225 DMDG(I)=DMDG(I)-DEL(I)*((DROAT+DROBT)*GAMA+OMG*DROCT)
  227 DNS=(ROA(N)+ROB(N))*GAMA+OMG*ROC(N)
      RON(I)=RON(I)+DNS
      IF(N-1) 2251,2253,2251
 2251 IF(DNS-DNCP(IE)) 2253,2252,2252
 2252 CPE(IE)=DEL(I)*((FLOAT(  )-0.5)/FJF+1.-FLOAT(I))*12.+RA(I)
      IF(ABS(DNS-DENOLD)-1.0E-20) 2254,2259,2259
 2259 CPE(IE)= CPE(IE)-DEL(I)/(DNS-DENOLD)*(DNS-DNCP(IE))/FJF*12.0
 2254 CPE(IE)=AMAX1(CPE(IE),SA)
      IE=IE+1
 2253 DENOLD=DNS
  255 TAS=TAS+DTA
  264 DMDG(I)=DMDG(I)/FJF*RR(I)
      RON(I)=RON(I)/FJF
      IF(I-1) 257,257,254
  257 FJF=FJFS
      DTA=DTA/DEL(1)*DEL(2)/2.*RR(2)
      GO TO 252
  254 DTA=DTA/DEL(I)*DEL(I+1)/RR(I)*RR(I+1)
  252 CONTINUE
      IF (NUBU) 2522,2522,2523
 2523 DO 700  I=1,NUBU
        GAM=GA(I)
        OMGAM=1. -GAM
        LL=NFI(I)
        LU=NLA(I)
        TRACMI=AMIN1(TRAC(I,1), TRAC (I,2), TRAC(I,3))
      DO 702     J=LL,LU
        DMDG(J)=0.
      IF(TA(J)-TRACMI) 702,702,703
  703 DO 709 K=1,3
      IF(TA(J)-TRAC(I,K)) 705,705,706
  705   DROT(K)=0.
      GO TO 709
  706   RD=ROCOM(J,K)-RHOR(I,K)
      IF(RD-0.01) 705,705,7060
 7060   F=FF(I,K)
```

```
          E=EE(I,K)
          POW=1.-PSI(I,K)
      IF(POW) 707,708,707
  707     DROT(K)=(-RD+((RD**POW)-F*EXP(-E/TA(J))*DTH)**(1./POW))/DTH
      GO TO 709
  708     BF=BBB(I,K)
          DROT(K)=RD*(EXP(-BF*DTH*EXP(-E/TA(J)))-1.)/DTH
  709     ROCOM(J,K)=ROCOM(J,K)+DROT(K)*DTH
          DMDG(J)=-DEL(J)*((DROT(1)+DROT(2))*GAM+OMGAM*DROT(3))/RR(J)
  701     RON(J)=(ROCOM(J,1)+ROCOM(J,2))*GAM+OMGAM*ROCOM(J,3)
  702 CONTINUE
  700 CONTINUE
C     NOW SPECIFY NECESSARY NEW POST-DECOMPOSITION PROPERTIES
 2522 J=JFMP
      MATL(NL+1)=ISV
      DO 85 I=1,NL
      IF(ABS(RON(I)-RHO(1))-.01) 81,81,82
   81 MATL(I)=1
      X(I)=1.0
      GO TO 85
   82 IF (ABS(RON(I)-RHO(2))-.01) 83,83,84
   83 MATL(I)=2
      X(I)=0.
      CN(I)=CNC(I)
      GO TO 85
   84 MATL(I)=0
      X(I)=PETE-PET/RON(I)
      IF (NT) 8500,8500,8501
 8501 L=NT
      CALL LOOK(31+L,X(I),TX(1,L),F1(1,L),F2(1,L),0,0,Y1,D1,2)
      CN(I)=Y1(1)*CN(I)+Y1(2)*CNC(I)
      GO TO 85
 8500 CN(I)=X(I)*CN(I)+(1.0-X(I))*CNC(I)
   85 RAT(I)=DEL(I)/(CN(I)*RR(I))
      IF (NUBU) 7121,7121,7122
 7122 DO 710  I=1,NDBU
          LL=NFI(I)
          LU=NLA(I)
      DO 711     J=LL,LU
      IF(ABS(RON(J)-RHOV(I))-.01) 712,712,713
  712     MATL(J)= 20+2*I
          X(J)=1.0
      GO TO 716
  713  IF(ABS(RON(J)-RHOC(I))-.01) 714,714,715
  714     MATL(J)=21+2*I
      X(J)=0.
      RON(J)=RHOC(I)
      CN(J)=CNC(J)
      GO TO 716
  715     MATL(J)=0
          X(J)=P(I)-PP(I)/RON(J)
      IF(NBUFT(I)) 7151,7151,7150
 7150 L=NBUFT(I)
      CALL LOOK(31+L,X(J),TX(1,L),F1(1,L),F2(1,L),0,0,Y1,D1,2)
      CN(J)=Y1(1)*CN(J)+Y1(2)*CNC(J)
      GO TO 716
 7151 CONTINUE
          CN(J)=X(J)*CN(J)+(1.0-X(J))*CNC(J)
  716     RAT(J)=DEL(J)/(CN(J)*RN(J))
  711 CONTINUE
  710 CONTINUE
 7121 GSM= 0.0
      DO 122 I=1,NL
  122 GSM=GSM+DMDG(I)
      GSMS=GSM
      GSMT=GSMT+GSMS*ASU/AREA(1)*DTH
          GSM2=0.
      IF (NUBU)   7100,7100,7101
 7101 DO 717  I=1,NDBU
          LL=NFI(I)
          LU=NLA(I)
      DO 718     J=LL,LU
  718     GSM2=GSM2+DMDG(J)
  717 CONTINUE
 7100 GSM2S=GSM2
          GSM2T=GSM2T+GSM2S*ASU/AREA(1)*DTH
          GS=GSMS+GSM2S
          GSM=GS
      UCDT=(CPE(1)-COLD)/DTH
      DPDT=(CPE(2)-POLD)/DTH
C
C         CALCULATION OF IMPLICIT TEMPERATURE COEFFICIENTS
C         AND INTERNAL ENERGY RATE TERMS
C     MAIN BLOCK
      DVB=0.
      SOEGR=0.
      GSEGR=0.
      TB=0.
      RAT(1)=2.*RAT(1)
      CPNL=CP(NL)
```

```
      NLM=NL-1
      ININ=0
      DO 30 I=ININ,NLM
      IF (I) 15,15,14
   14 GSM=GSM-DMDG(I)
      DRODTD=-DMDG(I)/(RR(I)*DEL(I))
      FACT1=DTM/(DEL(I)*RR(I))
      FACT2=GSM/(DEL(I)*RR(I))
      A(I)=-FACT1*DVB
      DVB=1.0/(0.5*(RAT(I)+RAT(I+1))+RC(I)/RR(I))
      TERM2=RON(I)*CP(I)-DTM*(CPGAS*(DRODTD-FACT2)
     1           -DSDT*RO1*CP1/DEL(I))
      TERM1=FACT1*DVB
      B(I)=TERM2-A(I)+TERM1
      C(I)=-TERM1
      D(I)=TA(I)*TERM2+(HGAS*DRODTD-HBAR*(RON(I)
     1       -RO(I))/DTM-FACT2*HGAS-DSDT*RO1*H1/DEL(I))*DTM
   15 RO1=ROT(I+1)
      X1=PETE-PET/RO1
      CP1=CPV(I+1)*X1+CPC(I+1)*(1.0-X1)
      H1=HP(I+1)*X1+HC(I+1)*(1.0-X1)
      CP(I+1)=CPV(I+1)*X(I+1)+CPC(I+1)*(1.0-X(I+1))
      TN=-RO1*HBAR+HO1*H1+T
      HBAR=PETE*HP(I+1)-PET/RHO(I)*HC(I+1)
      T=-RO1*H1+RO1*HBAR
   20 CALL LOOK (2,TA(I+1),TT1,THG,0,0,0,HGAS,CPGAS,1)
      HGAS=HGAS+DELHG
      GSEGR=GSEGR+HGAS*DMDG(I+1)
      SOEGR=SOEGR+HBAR*DMDG(I+1)
      IF (I) 24,24,25
   24 EGO=GSHS*HGAS
      HW=HGAS
      GO TO 30
   25 TERM3=(-FACT2*CPGAS-DSDT*RO1*CP1/DEL(I))*DTM
      C(I)=C(I)+TERM3
      D(I)=D(I)+TA(I+1)*TERM3+(FACT2*HGAS+DSDT*RO1*H1/DEL(I))*DTM
      TB=TB-TN*DSDT*RR(I)
   30 CONTINUE
      A(1)=DTM/DEL(1)
      TT=TT+TB*DTM/AREA(1)*ASU
C     NOW THE LAST ABLATING NODE REQUIRES DIFFERENT TREATMENT
      DROUTD=-DMDG(NL)/(RR(NL)*DEL(NL))
      FACT1=DTM/(DEL(NL)*RR(NL))
      A(NL)=-FACT1*DVB
      DVB=1.0/(0.5*(RAT(NL)+RAT(NBN))+RC(NL)/RR(NL))
      C(NL)=-FACT1*DVB
      TERM2=RON(NL)*CP(NL)-(CPGAS*DRODTD+(DSDT/DEL(NL))*
     1          (RO (NL)*CPNL  -RO1*CP1))*DTM
      B(NL)=TERM2-C(NL)-A(NL)
      D(NL)=TA(NL)*TERM2+DTM*(HGAS*DRODTD-HBAR*(RON(NL)-
     1          RO(NL))/DTM+DSDT*(RO (NL)*H(NL)-RO1*H1)/DEL(NL))
      K = NL
      GSM=GSM-DMDG(NL)
      IF(NDBU) 7170,7171,7170
 7170 FACT2=GSM/(DEL(NL)*RR(NL))
      TERM2=FACT2*CPGAS*DTM
      B(NL)=B(NL)+TERM2
      D(NL)=D(NL)+TA(NL)*TERM2-FACT2*HGAS*DTM
      CALL LOOK(2,TA(NBN),TT1,THG,0,0,0,HGAS,CPGAS,1)
      HGAS=HGAS+DELHG
      C(NL)=C(NL)-FACT2*CPGAS*DTM
      D(NL)=D(NL)-TA(NBN)*FACT2*CPGAS*DTM+FACT2*HGAS*DTM
 7171 CONTINUE
C-----NOW FOR DECOMPOSING BACK-UPS IF ANY
      IF (NDBU) 7250,7250,7251
 7251 DO 720  L=1,NDBU
      LL=NFI(L)-1
      LU=NLA(L)
      DO 7241  I=LL,LU
      IF(I-NFI(L)+1) 725,726,725
  725    GSM=GSM-DMDG(I)
      DVBS=DVB
         K=K+1
         DRODTD=-DMDG(I)/(RR(I)*DEL(I))
         FACT1=DTM/(DEL(I)*RR(I))
         FACT2=GSM/(DEL(I)*RR(I))
         A(K)=-FACT1*DVB
         DVB=1.0/(0.5*(RAT(I)+RAT(I+1))+RC(I)/RR(I))
         TERM2=RON(I)*CP(I)-DTM*(CPGAS*(DRODTD-FACT2))
         TERM1=FACT1*DVB
         B(K)=TERM2-A(K)+TERM1
         C(K)=-TERM1
         D(K)=TA(I)*TERM2+(HGAS*DRODTD-HBAR*(RON(I)-RO(I))/DTM
     C    -FACT2*HGAS)*DTM
       IF(I-NLA(NDBU)) 726,727,727
  726    CP(I+1)=CPV(I+1)*X(I+1)+CPC(I+1)*(1.0-X(I+1))
       HBARS=HBAR
         HBAR=P(L)*HP(I+1)-PP(L)/RHOV(L)*HC(I+1)
       CALL LOOK (2,TA(I+1), TT1,THG,0,0,0,HGAS,CPGAS,1)
         HGAS=HGAS+DELHG
```

```
      IF(I-NF1(L)+1) 724,724,727
  727    TERM3= (-FACT2*CPGAS)*DTM
         C(K)=C(K)+TERM3
         D(K)=D(K)+TA(I+1)*TERM3+FACT2*HGAS*DTM
  724 CALL SSWTCH(5,KKSW)
      GO TO (7240,7241),KKSW
 7240 WRITE(KOUT,7270) I,K,L,DEL(I),RR(I),CP(I),CPV(I),CPC(I),HP(I),
     1HC(I),CH(I),RAT(I),RO(I),RON(I),X(I),DMDG(I),DRODTD,P(L),PP(L),
     2HGAS,CPGAS,DVB,DVBS,HBAR,HBARS,GSM,FACT1,FACT2,TERM1,TERM2,TERM3,
     3GA(L),OMGA(L),A(K),B(K),C(K),D(K)
 7270 FORMAT(5X,3I5,16E10.3/(20X,10E10.3))
 7241 CONTINUE
  720 CONTINUE
C     NOW FOR BACK UPS IF ANY
 7250 IF(NUMN-NBM2) 60,40,40
   40 DO 50 I=NBM2,NUMN
      K=K+1
      FACT1=DTM/(DEL(I)*RR(I))
      A(K) = -FACT1*DVB
      DVB=1.0/(0.5*(RAT(I)+RAT(I+1))*RC(I)/RR(I))
      C(K)=-FACT1*DVB
      B(K)=RO(I)*CP(I)-C(K)-A(K)
   50 D(K)=TA(I)*RO(I)*CP(I)
C     NOW IF THE LAST NODE WAS INSULATED WE MUST REPAIR LAST B AND C
   60 IF(MRES) 80,70,80
   70 B(K)=B(K)+C(K)
      C(K)=0.
C     NOW BEFORE GAUSS REDUCTION REWRITE LAST LINE OF MATRIX
   80 D(K)=D(K)-C(K)*TRES
      L=K
      DO 90 I=2,K
      L=L-1
      D(L)=D(L)-C(L)/B(L+1)*D(L+1)
   90 B(L)=B(L)-C(L)/B(L+1)*A(L+1)
      B(1)=B(1)/A(1)
      D(1)=D(1)/A(1)
      PGPU=EGO-GSEGR
      PGPUT=PGPUT+PGPU*DTM/AREA(1)*ASU
      DECOM=GSEGR-SOEGR
      DECOMT=DECOMT+DECOM*DTM/AREA(1)*ASU
C
C     SURFACE BOUNDARY CONDITION PACKAGE
C
      CHZ=CH
      AP1=A(1)
      ITL=10
      ITS=1
      SNET=(1.+SHELL)*SA-SHELL*CPE(1)
      IF(II-2) 2502,1420,2501
 1420 DSDTB=QRA/12000.0
      TA(1)=HE
      HE=0.
      HW=0.0
      QR=0.0
      CHD=DSDTB*((ROA(1)+ROB(1))*GAMA+ROC(1)*QNB)
      RAD=0.
      QRA=0.
      QCHEM=0.
      QCONV=0.
      GO TO 1437
 2501 TABC=V0000.0
      DSDTB=0.
      ENFA=U(1)
      QCHEM=0.
      QCONV=0.
      GO TO 2503
 2502 IF (NW) 1424,1424,1425
 1425 CH=CH/((1+SNET/ABS(WSV))**REA)
      CHZ=CH
 1424 GO TO (1427,1428),NFIS
 1427 BF=(CHD-CHFL+ QB)/CH
      GO TO 1429
 1428 BF=(CHD-CHFL)/CH
 1429 CONTINUE
      PHI=2.*BMP*BF
      IF(PHI-.01)1422,1422,1423
 1422 CH=CH*(1.-.5*PHI)
      GO TO 1426
 1423 CH=CH/(EXP(PHI)-1.)*PHI
 1426 GO TO (14260,14261),NFIS
14260 CH=AMAX1(CH,QS/AMAX1(TMB(1),TMB(NMB)))
14261 CONTINUE
      ENFA=CH*HE+D(1)
      CALL LOOK (12,0b  /(CH*CHW),TMB,0,0,0,0,Y2,B2,0)
      ING=IR(12)
      VHM=VH
      IPR=1
      IF(NPR-1) 2510,2510,2511
 2511 CALL LOOK(13,PRES,TPR,0,0,0,0,Y2,B2,0)
      IPR=IR(13)
```

```
      ILO(16)=NLO(IMG,IPR+1)
      IHI(16)=NHI(IMG,IPR+1)
      ILO(17)=NLO(IMG+1,IPR+1)
      IHI(17)=NHI(IMG+1,IPR+1)
      VRP=VR
      I3=ILO(16)
      I4=ILO(17)
 2510 ILO(14)=NLO(IMG,IPR)
      IHI(14)=NHI(IMG,IPR)
      ILO(15)=NLO(IMG+1,IPR)
      IHI(15)=NHI(IMG+1,IPR)
      I1=ILO(14)
      I2=ILO(15)
      IF(NPR-1) 2512,2512,2513
 2513 IF(IHI(17)-I4) 420,420,2514
 2514 IF(IHI(16)-I3) 420,420,2512
 2512 IF(IHI(14)-I1) 420,420,2504
 2504 IF(IHI(15)-I2) 420,420,2505
 2505 TABC=TTS(I1,IMG,IPR)+VRM*(TTS(I2,IMG+1,IPR)-TTS(I1,IMG,IPR))
      IF(NPR-1) 2503,2503,2515
 2515 TABC=TABC+VRP*(TTS(I3,IMG,IPR+1)+VR*(TTS(I4,IMG+1,IPR+1)-TTS(I3,IM
     1G,IPR+1))-TABC)
 2503 IF(TSAVE-TABC) 420,420,421
C     ----------- ABLATING SURFACE
  421 IF(IAB) 422,422,423
  422 CHOL=TLMC(I1,IMG,IPR)-VR*(TLMC(I1,IMG,IPR)-TLMC(I2,IMG+1,IPR))
      CHO=EXP(CHOL)*CH
      IAB=1
  423 CALL LOOK(14,CHOL,TLMC(1,IMG,IPR),TTS(1,IMG,IPR),TCHEM(1,IMG,IPR),
     1TBPF(1,IMG,IPR),0,Y2(1),Y2(4),3)
      IRA=IR(14)
      CALL LOOK(15,CHOL,TLMC(1,IMG+1,IPR),TTS(1,IMG+1,IPR),TCHEM(1,IMG+1
     1,IPR),TBPF(1,IMG+1,IPR),0,Y2(7),Y2(10),3)
      IRB=IR(15)
      IF(NPR-1) 4233,4233,4231
 4231 CALL LOOK(16,CHOL,TLMC(1,IMG,IPR+1),TTS(1,IMG,IPR+1),TCHEM(1,IMG,I
     1PR+1),TBPF(1,IMG,IPR+1),0,Y2(13),Y2(16),3)
      IRC=IR(16)
      CALL LOOK(17,CHOL,TLMC(1,IMG+1,IPR+1),TTS(1,IMG+1,IPR+1),TCHEM(1,I
     1MG+1,IPR+1),TBPF(1,IMG+1,IPR+1),0,Y2(19),Y2(22),3)
      IRD=IR(17)
      DO 4232 I=1,12
 4232 Y2(I)=Y2(I)+VRP*(Y2(I+12)-Y2(I))
      IF(NBPF) 4237,4237,4238
 4238 IF(VRP-1.) 4234,4234,4235
 4235 Y2(3)=Y2(15)
      Y2(9)=Y2(21)
      GO TO 4237
 4234 IF(VRP) 4236,4237,4237
 4236 Y2(3)=(Y2(3)-Y2(15)*VRP)/(1.-VRP)
      Y2(9)=(Y2(9)-Y2(21)*VRP)/(1.-VRP)
 4237 CONTINUE
 4233 DO 426 I=1,6
  426 Y2(I)=Y2(I)+VRM*(Y2(I+6)-Y2(I))
      IF(Y2(1)) 4260,4260,4261
 4260 ITL=ITS
      GO TO 4356
 4261 CONTINUE
      CALL LOOK(4,Y2(1),TT2(1,2),TEP(1,2),0,0,0,EMIV,DMIV,1)
      IF(MATL(1)-2) 428,427,428
  428 CALL LOOK(3,Y2(1),TT2(1,1),TEP(1,1),0,0,0,Y3,D3,1)
      EMIV=EMIV+XP1*(Y3-EMIV)
      DMIV=DMIV+XP1*(D3-DMIV)
  427 TSSQ=Y2(1)*Y2(1)
      TS=Y2(1)
      RAD=SIG*EMIV*TSSQ*TSSQ*VF
  436 ERR=CH*Y2(2)+EMIV*QRA-RAD-B(1)*TS+ERFX
      DERR=CH*Y2(5)+((QRA-RAD/EMIV)*DMIV-4./TS*RAD-B(1))*Y2(4)
      ERRC=ERR/DERR
      VITER(ITS)=CHOL
      EITER(ITS)=ERR
      CHOL=CHOL-ERRC
      CHMI=-1.E+30
      CHMA=+1.E+30
      IF(ILO(14)-IRA) 4361,4363,4363
 4361 IF(ILO(15)-IRB) 4362,4363,4363
 4362 IF(NPR-1) 4270,4270,4271
 4271 IF(ILO(16)-IRC) 4272,4363,4363
 4272 IF(ILO(17)-IRD) 4273,4363,4363
 4273 CHMI=AMAX1(TLMC(IRD,IMG+1,IPR+1)+TLMC(IRD-1,IMG+1,IPR+1),TLMC(IRC,
     1IMG,IPR+1)+TLMC(IRC-1,IMG,IPR+1))
C        GMI,BRI(CMLT,)RPI,GMI,1-ARI(CMLT+)RPI,GMI,ARI(CMLT,IMMC(FIXAM=IMC
 4270 CHMI=AMAX1(CHMI,TLMC(IRA,IMG,IPR)+TLMC(IRA-1,IMG,IPR),TLMC(IRB,IMG
     1+1,IPR)+TLMC(IRB-1,IMG+1,IPR))/2.
      CHOL=AMAX1(CHOL,CHMI)
 4363 IF(IHI(14)-IRA-1) 4366,4366,4364
 4364 IF(IHI(15)-IRB-1) 4366,4366,4274
 4274 IF(NPR-1) 4275,4275,4276
 4276 IF(IHI(16)-IRC-1) 4366,4366,4277
 4277 IF(IHI(17)-IRD-1) 4366,4366,4278
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```
 4278 CMMA=AMIN1(TLMC(IRD+1,IMG+1,IPR+1),TLMC(IRD+2,IMG+1,IPR+1),
     1TLMC(IRC+2,IMG,IPR+1))
C        1+SM1(CMLT,)RP1,GM1,2+AR1(CMLT+)RP1,GM1,1+AR1(CMLT,AMMC(FINIM=AMC
 4275 CMMA=AMIN1(CMMA,TLMC(IRA+1,IMG,IPR)+TLMC(IRA+2,IMG,IPR),TLMC(IRB+1
     1,IMG+1,IPR)+TLMC(IRB+2,IMG+1,IPR))/2.
      CMDL=AMIN1(CMDL,CMMA)
      IF(ITS-ITL-1) 4366,4351,4352
 4351 ERRS=ERR
      CMDL=CMMA
      GO TO 4367
 4352 IF(ERR*ERRS) 4354,4367,4353
 4353 CMDL=CMMA
      GO TO 4367
 4354 ITL=55
      IF(ERRC) 4355,4367,4367
 4355 CMDL=CMM1
      GO TO 4367
 4366 IF(ITS-ITL) 4367,4356,4367
 4356 CMDL=AMIN1(TLMC(I1,IMG,IPR),TLMC(I2,IMG+1,IPR))
      IF(NPH-1) 4367,4367,4279
C                  ))1+RPI,1+GM1,4I(CMLT,)1+RPI,GMI,3I(CMLT,LDMC(FINIM=LDC
 4279 CMDL=AMIN1(CMDL,TLMC(I3,IMG,IPR+1),TLMC(I4,IMG+1,IPR+1))
 4367 CMD=EXP(CMDL)*CM*CMM
      IF(ITS-50) 440,440,998
  440 ITS=ITS+1
      IF(ABS(ERR )-1.  ) 4372,4372,423
C     ----------  NON-ABLATING SURFACE
  420 TS=TSAVE
      IAB=0
      CMD=0.0
  430 IF(II-3) 4302,433,4302
 4302 ILO(18)=1
      IHI(18)=KHI(IMG,IPR)
      ILO(19)=1
      IHI(19)=KHI(IMG+1,IPR)
      CALL LOOK (18,TS,TTS(1,IMG,IPR),TCHEM(1,IMG,IPR),0,0,0,Y2(1),Y2(2)
     1,1)
      CALL LOOK (19,TS,TTS(1,IMG+1,IPR),TCHEM(1,IMG+1,IPR),0,0,0,Y2(3),
     1Y2(4),1)
      IF(NPH-1) 4322,4322,4303
 4303 ILO(20)=1
      IHI(20)=KHI(IMG,IPR+1)
      ILO(21)=1
      IHI(21)=KHI(IMG+1,IPR+1)
      CALL LOOK (20,TS,TTS(1,IMG,IPR+1),TCHEM(1,IMG,IPR+1),0,0,0,Y2(5),
     1Y2(6),1)
      CALL LOOK (21,TS,TTS(1,IMG+1,IPR+1),TCHEM(1,IMG+1,IPR+1),0,0,0,
     1Y2(7),Y2(8),1)
      DO 4321 I=1,4
 4321 Y2(I)=Y2(I)+VHP*(Y2(I+4)-Y2(I))
 4322 DO 4323 I=1,2
 4323 Y2(I)=Y2(I)+VRM*(Y2(I+2)-Y2(I))
  433 CALL LOOK (4,TS,TT2(1,2),TEP(1,2),0,0,0,EMIV,DMIV,1)
      IF(MATL(1)-2) 434,442,434
  434 CALL LOOK (3,TS,TT2(1,1),TEP(1,1),0,0,0,Y3,D3,1)
      EMIV=EMIV+AP1*(Y3-EMIV)
      DMIV=DMIV+AP1*(D3-DMIV)
  442 TSSQ=TS*TS
      IF(II-3) 4422,4421,4422
 4421 IF (EMIV) 4422,4423,4422
 4423 EMIV=1.0
 4422 RAD=SIG*EMIV*TSSQ*TSSQ*VF
  439 ERR=CM*Y2(1)+EMIV*QRA-RAD-B(1)*TS+ERFX
      DERR=CM*Y2(2)+((QRA-RAD/EMIV)*DMIV-4./TS*RAD-B(1))
      ERRC=ERR/DERR
      VITER(ITS)=TS
      EITER(ITS)=ERR
      TS=TS-ERRC
      IF(II-3) 4391,4507,4507
 4391 TSMI=-1.E+30
      TSMA=+1.E+30
      IRA=IH(18)
      IRB=IH(19)
      IRC=IH(20)
      IRD=IH(21)
      IF(ILO(18)-IRA) 4500,4501,4501
 4500 IF(ILO(19)-IRB) 4502,4501,4501
 4502 IF(NPH-1) 4503,4503,4504
 4504 IF(ILO(20)-IRC) 4505,4501,4501
 4505 IF(ILO(21)-IRD) 4506,4501,4501
 4506 TSMI=AMAX1(TTS(IRD,IMG+1,IPR+1)+TTS(IRD-1,IMG+1,IPR+1),TTS(IRC,
     1IMG,IPR+1)+TTS(IRC-1,IMG,IPR+1))
 4503 TSMI=AMAX1(TSMI,TTS(IRB,IMG+1,IPR)+TTS(IRB-1,IMG+1,IPR),
     1TTS(IRA,IMG,IPR)+TTS(IRA-1,IMG,IPR))/2.
      TS=AMAX1(TS,TSMI)
 4501 IF(IHI(18)-IRA-1) 4507,4507,4508
 4508 IF(IHI(19)-IRB-1) 4507,4507,4509
 4509 IF(NPH-1) 4510,4510,4511
 4511 IF(IHI(20)-IRC-1) 4507,4507,4512
 4512 IF(IHI(21)-IRD-1) 4507,4507,4513
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```
4513 TSMA=AMIN1(TTS(IRD+1,IMG+1,IPR+1)+TTS(IRD+2,IMG+1,IPR+1),
    1TTS(IRC+1,IMG,IPR+1)+TTS(IRC+2,IMG,IPR+1))
4510 TSMA=AMIN1(TSMA,TTS(IRB+1,IMG+1,IPR)+TTS(IRB+2,IMG+1,IPR),
    1TTS(IRA+1,IMG,IPR)+TTS(IRA+2,IMG,IPR))/2.
     TS=AMIN1(TS,TSMA)
4507 CONTINUE
     IF(ITS-50) 441,441,998
 441 ITS=ITS+1
     IF(ABS(ERR )-1.  ) 4390,4390,430
 998 WRITE (KOUT,529)
     WRITE(KOUT,582) (WITER(I),EITER(I),I=1,51)
     WRITE(KOUT,582) TH,DTH,VRM,ERFA,TABC,EMIV,DMIV,RAD,B(1),CH,PHI,
    1 D(1),HE,FP1,QRA,Y2(1),Y2(2),Y2(3),Y2(4)
     TH=THFIN
     GO TO 3000
C    ----------  POST ITERATION
4390 IF(II-2) 4371,4371,1437
4371 Y2(2)=Y2(1)
4372 QCHEM=Y2(2)
     IF(ISEN(1))4373,4374,4373
4374 QCONV=0.
     GO TO 1439
4373 CALL OGLE(1,TS,QCONV,ISEN(IPR),TTSEN(1,IPR),THSEN(1,IPR),TCPSEN(1,
    1IPR))
     IF(NPR-1) 1439,1439,1438
1438 CALL OGLE(1,TS,QQ    ,ISEN(IPR+1),TTSEN(1,IPR+1),THSEN(1,IPR+1),TCP
    1SEN(1,IPR+1))
     QCONV=QCONV+VRP*(QQ-QCONV)
1439 QCHEM=(QCHEM+QCONV)*CH
     HW=QCONV
     QCONV=CH*(HE-QCONV)
     OSDTB=CMD/RHO(2)
     IF(NBPF) 1437,1437,4375
4375 IF(IAB) 1437,1437,4376
4376 CHFL=EXP(Y2(3))*CH*CNM
1437 RO(1)=RON(1)
     BR=CH/CHZ
     QRP=EMIV*QRA
     QCOND=-D(1)+B(1)*TA(1)
     QCONVT=QCONVT+QCONV*DTH/AREA(1)*ASU
     QCHEMT=QCHEMT+QCHEM*DTH/AREA(1)*ASU
     QCONDT=QCONDT+QCOND*DTH/AREA(1)*ASU
     QRPT=QRPT+QRP*DTH/AREA(1)*ASU
     RADT=RADT+RAD*DTH/AREA(1)*ASU
C
     DEDT=RON(1)*CP(1)*(TS-TSAVE)*DEL(1)/DTH
     DO 95 I=2,NL
     RO(I) = RON(I)
     TEMP =(D(I   )-A(I   )*TA(I-1))/B(I   )
     DEDT=DEDT+RON(I)*CP(I)*(TEMP-TA(I))*DEL(I)*RR(I)/DTH
  95 TA(I)=TEMP
     IF (NUMN-NBM) 97,96,96
  96 K=NL
     TA(NBM-1) = TA(NL)
     DO 98 I = NBM,NUMN
     K = K+1
  98 TA(I) = (D(K)-A(K)*TA(I-1))/B(K)
  97 DEDTT=DEDTT+DEDT*DTH/AREA(1)*ASU
     IF(NDBU) 755,756,755
 755 LL=NFI(1)
     LU=NLA(NDBU)
     DO 757 I=LL,LU
 757 RO(I)=RON(I)
 756 CONTINUE
C
C
C    SHRINK (AND DROP) OF LAST ABLATING NODE
C
C    DEL(NL)=DEL(NL)-US (SEE INT DECOMP)
     IF(DEL(NL)-DELM)149,149,150
 149 DRLP=DEL(NL)*RO(NL)*RR(NL)
     DRLCP=DRLP*CP(NL)
     NL=NL-1
     RC(NL)=RC(NL+1)
     DRL=DEL(NL)*RO(NL)*RR(NL)
     DRLC=DRL*CP(NL)
     HAPHB=DRL*H(NL)+DRLP*H(NL+1)
     TOP1=DRL+DRLP
     TOP2=DRLC+DRLCP
     TOP3=DRLC*TA(NL) +DRLCP*TA(NL+1)
     VOL=DEL(NL)*RR(NL)+DEL(NL+1)*RR(NL+1)
     DEL(NL)=DEL(NL)+DEL(NL+1)
     RA(NL)=RA(NL)+6.*DEL(NL+1)
     RO(NL)=TOP1/VOL
     CP(NL)=TOP2/TOP1
     TA(NL)=TOP3/TOP2
     H(NL)=HAPHB/TOP1
     DELR=DEL(NL+1)*RR(NL+1)/VOL
     CZ=1.0-DELR
     DZ=0.0
```

```
      GZ=CZ                                                    CBN 1171
      NZ=JF*NL-JFM                                             CBN 1172
      N=NZ-JF+1                                                CBN 1173
      K=N                                                      CBN 1174
      FZ=DELR                                                  CBN 1175
      EZ=GZ                                                    CBN 1176
      GO TO 179                                                CBN 1177
  172 DZ=DZ+1.0                                                CBN 1178
  173 FZ=DZ-CZ                                                 CBN 1179
      IF(K-NZ) 175,174,175                                     CBN 1180
  174 GZ=DELR                                                  CBN 1181
  175 K=K+1                                                    CBN 1182
      CZ=CZ+GZ                                                 CBN 1183
  176 EZ=CZ-DZ                                                 CBN 1184
      IF(EZ)178,177,177                                        CBN 1185
  177 ROA(N)=ROA(N)+FZ*ROA(K)                                  CBN 1186
      ROB(N)=ROB(N)+FZ*ROB(K)                                  CBN 1187
      ROC(N)=ROC(N)+FZ*ROC(K)                                  CBN 1188
      IF(N-NZ) 171,150,171                                     CBN 1189
  171 N=N+1                                                    CBN 1190
  179 ROA(N)=ROA(K)*EZ                                         CBN 1191
      ROB(N)=ROB(K)*EZ                                         CBN 1192
      ROC(N)=ROC(K)*EZ                                         CBN 1193
      GO TO 172                                                CBN 1194
  178 ROA(N)=ROA(N)+RUA(K)*GZ                                  CBN 1195
      ROB(N)=ROB(N)+RUB(K)*GZ                                  CBN 1196
      ROC(N)=ROC(N)+RUC(K)*GZ                                  CBN 1197
      GO TO 173                                                CBN 1198
C                                                              CBN 1199
  150 GO TO 410                                                CBN 1200
    1 RETURN                                                   CBN 1201
      END                                                      CBN 1202
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17:18:00   * FIN

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      SUBROUTINE INPOUT
      COMMON KOUT,IEX,DEN,VR
      COMMON IHI(38),ILO(38),IR(38),TT2(30,10),TCP(30,10),TKP(30,10),THZ
     1(30,10),TEP(30,10),TTH(30),THE(30),TUR(30),TCM(30),TT1(30),THG(30)
     2,DH12(2),RECORD(36),SO(20)
      COMMON RHO(10)
      COMMON MATL( 50),DEL( 51),TA( 51),H(50),RC(50),RA( 50),
     1AREA( 50),EMA( 50),RAV( 50)
      COMMON ROA( 500),ROB( 500),ROC( 500)
      COMMON TPR(3),NMG(3),TMG(15,3),NLO(15,3),NHI(15,3),
     1KHI(15,3),TTSEN(25,3),THSEN(25,3),TCPSEN(25,3),TLMC(25,15,3),
     2ISEN(3),TP1(30),TTS(25,15,3),TCHEM(25,15,3),VFZ,CMH
      COMMON TBPF(25,15,3)
      COMMON NPR
      COMMON LCT,NPG,II,NBM,NUMN,NL,DELHG,DELM,RFT,RHORA,RHORB,RHORC,TRA
     1CA,TRACB,TRACC,RHOOA,RHOOB,RHOOC,EA,EB,EC,BA,BB,BC,PSIA,PSIB,PSIC,
     2TRACM,PET,PETE,HSV,ETA,DTPR3,DTPR2,DTPRT,TPR3,TPR2,THZRO,THFIN,WT,
     3THWT,GAMA,OMG,NU,FJFH,FJFS,JF,JFHP,JFH,INPUT,      DTHIN,BRP,HCONV,
     4EPSW,TRES
      COMMON INCH,DTHB
      COMMON NN,NI,NO1
      COMMON CHCRI,PYCRI
      COMMON TBRP(30)
      COMMON NR
      COMMON TX(30,6),F1(30,6),F2(30,6)
      COMMON NCON
      COMMON NBPF,NFIS
      COMMON BREX,SWELL
      COMMON BBB(5,3),EE(5,3),FF(5,3),PSI(5,3),RHOO(5,3),RHOR(5,3),
     1ROCOM(50,3),DHC(5),DHV(5),RHOC(5),RHOV(5),P(5),PP(5),TREF(5),GA(5)
     2,OMGA(5),NFI(5),NLA(5),TTS(30,10),TENT(30,10),TKBU(30,10),TCBU(30,
     310),X(50),NOBU,NBM2
      COMMON TRAC(5,3)
      COMMON NBUFT(5)
      COMMON/DATA/ASTER,BLANK
      DIMENSION TZSEN(25,3),TCZSEN(25,3),TSURF(25),TSEN(25),IZ(25)
      DIMENSION IOPT(30)
      DIMENSION KSV(5),KMTL(6)
      EQUIVALENCE (DH1,DH12(1)),(DH2,DH12(2)),(TS,TA)
  497 FORMAT(I2,3F10.5)
  499 FORMAT(12A6)
  502 FORMAT (6X12A6)
  503 FORMAT(//24X31H---REACTION KINETIC EQUATION---/1H )
  504 FORMAT(10X67HDRHO/DTIME = GAMMA ( BA*EXP(-EA/T)RHOOA((RHOA-RHORA)/
     1RHOOA)**PSIA )/   21X56H+ GAMMA ( BB*EXP(-EB/T)RHOOB((RHOB-RHORB)/
     2RHOOB)**PSIB )/ 19X58H+(1-GAMMA)( BC*EXP(-EC/T)RHOOC((RHOC-RHORC)/
     3RHOOC)**PSIC ))
  505 FORMAT(/24X32H---REACTION KINETIC CONSTANTS---/1H )
  506 FORMAT (11X8HREACTION2X4HRHOO5X4HRHOR8X1HB7X3HPSI8X1HE6X6HT REAC/2
     13X10H(LB/CU FT)6X7H(1/SEC)12X7H(DEG R)3X7H(DEG R))
  507 FORMAT (14XA1,2X2F9.2,2XE10.4,F7.2,2XE10.4,F8.0)
  510 FORMAT(12X31HRESIN VOLUME FRACTION, GAMMA = F5.3,17H(MASS FRACTION
     1 = F5.3,1H)/1H )
  511 FORMAT (24X32H---TIME INCREMENT INFORMATION---/1H )
  512 FORMAT (6X18HINITIAL TIME (SEC)F7.3,26X16HFINAL TIME (SEC)F7.2)
  513 FORMAT (1H /6X17HOUTPUT INTERVAL =F6.3,1X27HSEC FROM INITIAL TIME
     1UNTIL F7.3,4H SEC)
  514 FORMAT (6X17HOUTPUT INTERVAL =F6.3,1X8HSEC FROMF7.3,1X9HSEC UNTILF
     17.3,4H SEC)
  515 FORMAT (6X17HOUTPUT INTERVAL =F6.3,1X8HSEC FROMF7.3,1X20HSEC UNTIL
     1 FINAL TIME/1H )
  516 FORMAT (6X,19HMAXIMUM TIME STEP =,F4.2,8H SECONDS)
  517 FORMAT(/29X16H---NODAL DATA---/1H )
  518 FORMAT(6X74HNODE  MATL  TEMPERATURE  RELATIVE  THICKNESS  NODAL DE
     1PTH  CONT.RESISTANCE)
  519 FORMAT(7X73HNO.   NO. (DEG.RANKINE)    AREA     (INCHES)     (INCHES)
     1    (SQFT-S-DEG/BTU))
  520 FORMAT(3X2I6,F12.2,E13.4,F9.5,F12.6,A1,E15.4)
  521 FORMAT (      14X47HMINIMUM THICKNESS OF LAST ABLATOR NODE (INCHES)F
     17.4/14X,10HTHERE ARE ,I2,40H NODELETS ASSIGNED TO EACH ABLATING NO
     2DE)
  522 FORMAT(/18X48H---HEAT OF FORMATION OF MATERIAL CONSTITUENTS---/37X
     18H(BTU/LB)/21X7HPLASTIC11X4HCHAR17X3HGAS)
  523 FORMAT (20XF9.2,7XF9.2,11XF9.2)
  524 FORMAT(/7X28HENTHALPY DATUM TEMPERATURE =F9.3,1X11HDEG RANKINE)
  525 FORMAT     (//22X36H---MATERIAL THERMAL PROPERTY DATA---//6X14HMATER
     1IAL NO. 110X14HMATERIAL NO. 210X26HMATERIAL NOS. 3 THROUGH 10/6X14
     2HVIRGIN PLASTIC15X4HCHAR23X7HBACK-UP)
  526 FORMAT(/6X12HMATERIAL NO.I2,30X9HDENSITY =F8.3,1X8HLB/CU FT/
     1         7X11HTEMPERATURE5X13HSPECIFIC HEAT5X12HCONDUCTIVITY5X8HSEN
     2SIBLE4X10HEMISSIVITY/58X8HENTHALPY/9X7H(DEG R)7X12H(BTU/LB-DEG)4X1
     36H(BTU/FT-SEC-DEG)3X8H(BTU/LB)/
     4         (8XF8.2,8XF7.4,9XF10.7,7XF9.2,4XF7.4))
 5260 FORMAT(/6X12HMATERIAL NO.I2,30X9HDENSITY =F8.3,1X8HLB/CU FT/
     1         7X11HTEMPERATURE5X13HSPECIFIC HEAT5X12HCONDUCTIVITY5X8HSEN
     2SIBLE               /58X8HENTHALPY/9X7H(DEG R)7X12H(BTU/LB-DEG)4X1
     36H(BTU/FT-SEC-DEG)3X8H(BTU/LB)/
     4         (8XF8.2,8XF7.4,9XF10.7,7XF9.2          ))
  527 FORMAT(/6X12HMATERIAL NO.I2,30X9HDENSITY =F8.3,1X8HLB/CU FT/
     1         7X11HTEMPERATURE5X13HSPECIFIC HEAT5X12HCONDUCTIVITY/9X7H(D
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     2EG R)7X12H(BTU/LB-DEG)4X10H(BTU/FT-SEC-DEG)/
     3        (8XF8.2,4XF7.4,9XF10.7))
 531 FORMAT (1H /6X19HTEMPERATURE (DEG R)5F11.2)
 532 FORMAT    (//20X47H---RESIN DECOMPOSITION GAS SENSIBLE ENTHALPY---)
 533 FORMAT       (6X19HENTHALPY    (BTU/LB)5F11.2)
 534 FORMAT (1H //23X40H---TIME DEPENDENT BOUNDARY CONDITIONS---/1H )
 535 FORMAT (9X,4HTIME,8X,4HPROB,3X,8HRECOVERY,3X,9HRADIATION,4X,4HHEAT
     15X,8HPRESSURE,3X,7HBLOWING/9X,5H(SEC),7X,4HOPTN,3X,8HENTHALPY,3X,
     29HHEAT RATE,4X,5HCOEFF,14X,9HREDUCTION/20X,8H(BTU/LB),2X,11H(BTU/S
     3Q FT-,1X,10H(LB/SQ FT-,3X,5H(ATM),3X,9HPARAMETER /40X,7HSECOND),
     44X,7HSECOND))
 536 FORMAT (6X,F8.2,4X,I2,4X,2(F8.2,3X),F8.4,3X,F8.5,3X,F8.3)
 537 FORMAT (1H /9X,69HCH/CHO = PHI/(EXP(PHI)-1.) WHERE PHI = 2.*BMP*H
     1DOT/CHO. BRP IN TABLE)
 538 FORMAT(//27X30H---SURFACE EQUILIBRIUM DATA---)
 551 FORMAT(1H1)10X65HAEROTHERM CHARRING MATERIAL THERMAL RESPONSE AND A
     1BLATION PROGRAM/73X4HPAGEI3/1H 67X2A6)
 552 FORMAT (9X,4HTIME,8X,4HPROB,3X,7HSURFACE,4X,7HSURFACE/9X,5H(SEC),
     17X,4HOPTN,5X,4HTEMP,5X,9HRECESSION/28X,7H(DEG R),6X,4HRATE/38X,
     210H(MILS/SEC))
 553 FORMAT(8X24H*INITIAL INTERNAL RADIUS,1X,F6.3,4X,21HAREA PROP.TO RA
     1DIUS**F4.2)
 554 FORMAT(8X24H*INITIAL EXTERNAL RADIUS,1X,F6.3,4X,21HAREA PROP.TO RA
     1DIUS**F4.2)
 555 FORMAT(8X15H*PLANAR SURFACE)
 556 FORMAT (9X,4HTIME,8X,4HPROB,5X,4HVIEW,5X,9HRADIATION/9X,5H(SEC),
     17X,4HOPTN,4X,6HFACTOR,4X,9HHEAT RATE/38X,11H(BTU/SQ FT-/40X,
     27HSECOND))
 560 FORMAT(I2,5E10.0)
 561 FORMAT(I2,F8.4,6I1)
 563 FORMAT (I2,I3,I1,I2,I2,7F10.5/8F10.5)
 564 FORMAT(A1,9X,2F10.5,E10.3,F10.5,E10.3,F10.5/A1,9X,2F10.5,E10.3,
     1F10.5, E10.3,F10.5/A1,9X,2F10.5,E10.3,F10.5,E10.3,F10.5,9X,I1)
5640 FORMAT (A1,9X2F10.5,E10.3,F10.5,E10.3,F10.5)
 571 FORMAT(I2,F10.5,F10.5,F10.8,F10.5)
 575 FORMAT(I1,F9.5,7F10.5/8F10.5)
 577 FORMAT(I1,F9.5,3F10.5)
 579 FORMAT(12X2E12.5,2E13.6,I1)
5790 FORMAT (6X,26HNO RADIUS CORRECTION ON CH)
5791 FORMAT (3F8.5,F9.4,F5.3,2F9.3,I2,A6)
5792 FORMAT(//6X,3HP =,F9.4,4H ATM//6X,3(25HTEMPERATURE  EDGE ENTH.   )/
     16X,3(25H  (DEG R)     AT T-WALL    ))
5793 FORMAT (//6X,37HBAD SURFACE EQUILIBRIUM TABLE OF TYPE,I2)
5794 FORMAT (//6X,74HEQUAL MASS AND HEAT TRANSFER COEFFICIENTS AND EQUA
     1L DIFFUSION COEFFICIENTS/6X,29HNOMINAL SURFACE VIEW FACTOR =,
     2F6.3)
5795 FORMAT(//6X,14HM-DOT-GAS/CM =,F7.4,8X,10HPRESSURE =,F9.4,4H ATM//
     17X,21HTEMP,5X,26HM-DOT-  CHEM.PROD  SURFACE,3X)/6X,2(36H(DEG R)
     2CHAR/CM    (BTU/LB)  SPECIES,2X)/(5X,F8.2,2X,F7.4,2X,F8.2,4X,A6,1X,
     3F8.2,2X,F7.4,2X,F8.2,4X,A6))
5796 FORMAT(2F10.0,F9.0,I1,3(9X,I1),F10.0)
5797 FORMAT(//6X,45HRATIO OF MASS TO HEAT TRANSFER COEFFICIENTS =,F6.3/
     1 6X,28HUNEQUAL DIFFUSION EXPONENT =,F6.3/6X,29HNOMINAL SURFACE VIE
     2W FACTOR =,F6.3,11H (OPTION 1))
5798 FORMAT                            (6X,F9.2,4X,F9.2,3X,F9.2,4X,F9.
     22,3X,F9.2,4X,F9.2)
5799 FORMAT (6X,66HHEAT TRANSFER COEFFICIENT MULTIPLIED BY (R INITIAL/R
     1 CURRENT)**EX,/6X,63HWHERE EX = (1.0-.2N)/(1.-N) AND N IS THE BURN
     2ING RATE EXPONENT,/8X,40HIN THIS PROBLEM N HAS BEEN SET EQUAL TO ,
     3F8.5)
 580 FORMAT (8F10.5)
 581 FORMAT(/14X20HBACK WALL CONVECTION10X9HBACK WALL10X9HRESERVOIR/
     113X23HCOEF BTU/FTSQ-SEC-DEG R8X10HEMISSIVITY8X11HTEMPERATURE/
     217XF10.4,10XF6.3,10XF10.2)
 582 FORMAT(5F10.5,9X,I1)
     DATA BLANK,ASTER/1H ,1H*/
     INPUT=5
     KOUT=6
     INCH=5
     WT=0.0
     DO 3500 I=1,5
3500 NBUFT(I)=0
C    INPUT/OUTPUT
C
   1 NPG=1
     WRITE (KOUT,551)NPG
     READ  (INPUT, 499, END=999)  (RECORD(I), I=1,36)
C    READ  (INPUT, 499)           (RECORD(I), I=1,36)
     GO TO 998
C    IF (EOF, INPUT)  999, 998
 999 CONTINUE
     STOP
 998 CONTINUE
C                                                                 EUNITN
     WRITE (KOUT,582)(RECORD(I),I=1,36)
     WRITE (KOUT,583)
     WRITE (KOUT,584)
     WRITE (KOUT,585)
     WRITE (KOUT,586)
     READ (INPUT,564) A9,RHOOA,RHORA,BA,PSIA,EA,TRACA,B9,RHOOB ,RHORB,B
```

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     1B,PSIB,EB,TRACB ,C9,RHOOC,RHORC,BC, PSIC,EC,TRACC,NDBU              INPOU181
      WRITE (KOUT,567)A9,RHOOA,RHORA,BA,PSIA,EA,TRACA,B9,RHOOB,RHORB,BB,INPOU182
     1PSIB,EB,TRACB ,C9,RHOOC,RHORC,BC, PSIC,EC,TRACC                    INPOU183
      READ (INPUT,563) JF,NUMN,NN,NO,NI,THZRO,THFIN,DTPRT,DTPR2,DTPR3,  INPOU184
     1DTHB,BRP,TPR2,TPR3,DELM,DH1,DH2,DELMG,GAMA,TZ                      INPOU185
      IF(JF-1) 171,170,172                                               INPOU186
  170 JF=2                                                               INPOU187
      GO TO 172                                                          INPOU188
  171 JF=10                                                              INPOU189
  172 JFH=JF/2                                                           INPOU190
      JF=JFH+JFH                                                         INPOU191
      JFHP=JFH+1                                                         INPOU192
      FJFS=JF                                                            INPOU193
      FJFH=FJFS/2.0                                                      INPOU194
      NOI=NO+NI                                                          INPOU195
      IF (NO) 181,181,182                                                INPOU196
  182 READ  (INPUT,580)(SO(I),I=1,NO)                                    INPOU197
  181 CONTINUE                                                           INPOU198
      IF (NI) 184,184,183                                                INPOU199
  183 NOP=NO+1                                                           INPOU200
      READ (INPUT,580) (SO(I), I=NOP,NOI)                                INPOU201
  184 IF(GAMA) 408,409,409                                               INPOU202
  408 GAMA=RHOOC/(RHOOC-(RHOOA+RHOOB)-(RHOOA+RHOOB)/GAMA)                INPOU203
  409 OMG=1.0-GAMA                                                       INPOU204
      RHO(1)=GAMA*(RHOOA+RHOOB)+OMG*RHOOC                                INPOU205
      RHO(2)=GAMA*(RHORA+RHORB)+OMG*RHORC                                INPOU206
       GAMAM=GAMA/RHO(1)*(RHOOA+RHOOB)                                   INPOU207
      WRITE (KOUT,510)GAMA,GAMAM                                         INPOU208
      IF(NDBU) 700,701,700                                               INPOU209
  700 WRITE(KOUT,7900)                                                   INPOU210
 7900 FORMAT (/23X,34H---DECOMPOSING BACK-UP KINETICS---/)               INPOU211
      DO 704 I=1,NDBU                                                    INPOU212
      READ(INPUT,5640)A9,RHOO(I,1),RHOR(I,1),BBB(I,1),PSI(I,1),EE(I,1), INPOU213
     1TRAC(I,1),B9,RHOO(I,2),RHOR(I,2),BBB(I,2),        PSI(I,2),EE(I,2INPOU214
     2),TRAC(I,2),C9,RHOO(I,3),RHOR(I,3),BBB(I,3),PSI(I,3),EE(I,3),TRAC(INPOU215
     3I,3)                                                               INPOU216
      READ(INPUT,7901) DHV(I),DHC(I),GA(I),TREF(I)                       INPOU217
 7901 FORMAT (30X,2F10.5,10X,2F10.5)                                     INPOU218
      WRITE(KOUT,7902) I                                                 INPOU219
 7902 FORMAT (/20X,24HDECOMPOSING BACK-UP NO. ,I1)                       INPOU220
      WRITE(KOUT,506)                                                    INPOU221
      WRITE(KOUT,507) A9,RHOO(I,1),RHOR(I,1),BBB(I,1),PSI(I,1),EE(I,1), INPOU222
     1TRAC(I,1),B9,RHOO(I,2),RHOR(I,2),BBB(I,2),        PSI(I,2),EE(I,2INPOU223
     2),TRAC(I,2),C9,RHOO(I,3),RHOR(I,3),BBB(I,3),PSI(I,3),EE(I,3),TRAC(INPOU224
     3I,3)                                                               INPOU225
      IF(GA(I)) 702,703,703                                              INPOU226
  702 GA(I)=RHOO(I,3)/(RHOO(I,3)- (RHOO(I,1)+RHOO(I,2))-(RHOO(I,1)+     INPOU227
     1RHOO(I,2))/GA(I))                                                  INPOU228
  703 OMGA(I)=1.-GA(I)                                                   INPOU229
      RHOV(I)=GA(I)*(RHOO(I,1)+RHOO(I,2))+OMGA(I)*RHOO(I,3)              INPOU230
      RHOC(I)=GA(I)*(RHOR(I,1)+RHOR(I,2))+OMGA(I)*RHOR(I,3)              INPOU231
      GAMAM=GA(I)/RHOV(I)*(RHOO(I,1)+RHOO(I,2))                          INPOU232
      WRITE(KOUT,510) GA(I),GAMAM                                        INPOU233
      P(I)=RHOV(I)/(RHOV(I)-RHOC(I))                                     INPOU234
      PP(I)=P(I)*RHOC(I)                                                 INPOU235
      DO 7030 J=1,3                                                      INPOU236
 7030 FF(I,J)=(1.-PSI(I,J))*BBB(I,J)*(RHOO(I,J)**(1.-PSI(I,J)))          INPOU237
  704 CONTINUE                                                           INPOU238
  701 CONTINUE                                                           INPOU239
      IF(DTHB) 412,410,412                                               INPOU240
  410 DTHB=5.                                                            INPOU241
  412 DTMIN=.01                                                          INPOU242
  413 IF(TPR2)414,414,415                                                INPOU243
  414 TPR2=THFIN                                                         INPOU244
  415 IF(TPR3)416,416,417                                                INPOU245
  416 TPR3=THFIN                                                         INPOU246
      IF(TPR2-THZRO) 418,418,417                                         INPOU247
  418 DTPRT=DTPR2                                                        INPOU248
      DTPR2=DTPR3                                                        INPOU249
      TPR2=TPR3                                                          INPOU250
      GO TO 416                                                          INPOU251
  417 WRITE (KOUT,511)                                                   INPOU252
      THFIN=AMAX1(THFIN,TPR2,TPR3)                                       INPOU253
      WRITE (KOUT,512)THZRO,THFIN                                        INPOU254
      WRITE (KOUT,513)DTPRT,TPR2                                         INPOU255
      WRITE (KOUT,514)DTPR2,TPR2,TPR3                                    INPOU256
      WRITE (KOUT,515)DTPR3,TPR3                                         INPOU257
      WRITE (KOUT,516) DTHB                                              INPOU258
      TRACM=AMIN1(TRACA,TRACB,TRACC)                                     INPOU259
      PETE=RHO(1)/(RHO(1)-RHO(2))                                        INPOU260
      PFT=PETE*RHO(2)                                                    INPOU261
C     ----------  NODAL PROPERTIES                                       INPOU262
      N=0                                                                INPOU263
      KHS=10                                                             INPOU264
      NDBUCH=0                                                           INPOU265
      J1=JFH                                                             INPOU266
      CALL LCOUNT (-NUMN-8,LCT,NPG,RECORD(35))                           INPOU267
  302 WRITE (KOUT,517)                                                   INPOU268
      WRITE (KOUT,518)                                                   INPOU269
      WRITE (KOUT,519)                                                   INPOU270
```

```
      B=ASTER
      READ(INPUT,560)(MATL(I),TA(I),AREA(I),DEL(I),RA(I),RC(I),I=1,NUMN)
      AE=RA(2)
      RSV=RA(1)
      RA(1)=0.0
      DO 400 I=1,NUMN
      IF(I-2) 4541,452,453
  453 RA(I)=RA(I-1)+(DEL(I-1)+DEL(I))/2.0
      GO TO 461
  452 RA(2)=DEL(1)+DEL(2)/2.
      B=BLANK
  461 DEL(I-1)=DEL(I-1)/12.
 4541 RAV(I)=RA(I)
      IF(AE) 4542,4543,4542
 4542 AREA(I)=(ABS(RSV+RA(I)))**AE
      GO TO 454
 4543 IF(AREA(I)) 4544,4544,454
 4544 IF(RSV) 4545,4546,4545
 4545 AREA(I)=ABS(RSV+RA(I))
      AE=1.0
      GO TO 454
 4546 AREA(I)=1.
  454 WRITE(KOUT,520)I,MATL(I),TA(I),AREA(I),DEL(I),RA(I),B,RC(I)
      IF(MATL(I)-2) 401,405,705
  401 NL=I
      DO 404 J=1,J1
      N=N+1
      ROA(N)=RHOOA
      ROB(N)=RHOOB
  404 ROC(N)=RHOOC
      J1=JF
      GO TO 400
  405 NL=I
      DO 406 J=1,J1
      N=N+1
      ROA(N)=RHORA
      ROB(N)=RHORB
  406 ROC(N)=RHORC
      J1=JF
      GO TO 400
  705 IF(MATL(I)-10) 400,400,706
  706 K=MATL(I)-21
      VKH=FLOAT(K)/2.0
      KH=K/2
      IF(VKH-KH) 708,707,708
  707 ROCOM(I,1)=RHOR(KH,1)
      ROCOM(I,2)=RHOR(KH,2)
      ROCOM(I,3)=RHOR(KH,3)
      A(I)=0.
      GO TO 709
  708 KH=KH+1
      ROCOM(I,1)=RHOO(KH,1)
      ROCOM(I,2)=RHOO(KH,2)
      ROCOM(I,3)=RHOO(KH,3)
      A(I)=1.0
  709 IF(KH-KHS) 7090,7092,7090
 7090 NFI(KH)=I
      KHS=KH
      NOBUCH=NOBUCH+1
 7092 NLA(KH)=I
  400 CONTINUE
      IF(NOBU-NOBUCH) 7095,7094,7093
 7095 WRITE(KOUT,7096)
 7096 FORMAT(10X,55HTOO MANY DECOMPOSING BACK-UPS IN NODAL DATA -- QUIT
     13H)
      STOP
 7093 WRITE(KOUT,7097)
 7097 FORMAT(10X,54HTOO FEW DECOMPOSING BACK-UPS IN NODAL DATA -- QUIT J
     10B)
      STOP
 7094 CONTINUE
  403 DEL(NUMN)=DEL(NUMN)/12.
      CALL SLOPO(NUMN,RA,AREA,EMA)
      NBM=NL+1
      IF(NOBU) 7098,7099,7098
 7098 NUM2=NLA(NOBU)+1
      GO TO 7091
 7099 NUM2=NBM
 7091 CONTINUE
      IF(RSV) 4031,4032,4033
 4031 RSVN=-RSV
      WRITE(KOUT,554)RSVN,AE
      GO TO 304
 4032 WRITE(KOUT,555)
      GO TO 304
 4033 WRITE(KOUT,553)RSV,AE
  304 WRITE (KOUT,521) DELM,JF
      DELM=DELM/12.0
      READ(INPUT,502) MCONV,EPSW,TRES,CHCRI,PYCRI,NCON
      IF (CHCRI) 305,305,306
```

```
  305 CHCRI=0.02
  306 IF (PYCHI) 307,307,308
  307 PYCRI=0.98
  308 TA(NUMN+1)=TRES
      CALL LCOUNT(4            ,LCT,NPG,RECORD(35))
      WRITE(KOUT,561) HCONV,EPSW,TRES
      CALL LCOUNT(5            ,LCT,NPG,RECORD(35))
      WRITE (KOUT,522)
      WRITE (KOUT,523)DH1,DH2,DELHG
      CALL LCOUNT(2            ,LCT,NPG,RECORD(35))
      WRITE (KOUT,524)TZ
      IF(NDBU) 7910,7910,7907
 7907 DO 7908 J=1,NDBU
      CALL LCOUNT(6,LCT,NPG,RECORD(35))
      WRITE(KOUT,7902) J
 7909 FORMAT(/21X7HPLASTIC11X4HCHAR17X3HGAS)
      WRITE(KOUT,7909)
      WRITE(KOUT,523) DHV(J),DHC(J),DELHG
 7908 WRITE(KOUT,524) TREF(J)
 7910 CONTINUE
C     --------- MATERIAL PROPERTIES
      CALL LCOUNT(6            ,LCT,NPG,RECORD(35))
  310 WRITE (KOUT,525)
      CALL LCOUNT(3,LCT,NPG,RECORD(35))
      WRITE(KOUT,7905)
 7905 FORMAT(/3X,82HDECOMPOSING BACK-UP VIRGIN MATERIALS 22,24,26,28,30,
     1 CHAR MATERIALS 23,25,27,29,31)
      IT=0
      ILO(3)=1
      ILO(4)=1
      KT=1
  350 IT=IT+1
      READ (INPUT,571) NC,TT2(IT,KT),TCP(IT,KT),TKP(IT,KT),TEP(IT,KT)
      IF(NC)351,350,351
  351 IHI(KT+2)=ILO(KT+2)+IT-1
      IR(KT+2)=ILO(KT+2)
      THZ(1,KT)=0.
      DO 357 I=2,IT
  357 THZ(I,KT)=THZ(I-1,KT)+(TCP(I,KT)+TCP(I-1,KT))/2.*(TT2(I,KT)-TT2(I-
     11,KT))
      CALL LOOK (KT+2,IZ,TT2(1,KT),THZ(1,KT),0,0,0,HSM,DUM,1)
      DO 359 I=1,IT
  359 THZ(I,KT)=THZ(I,KT)-HSM
      CALL LCOUNT(6+IT         ,LCT,NPG,RECORD(35))
  312 WRITE(KOUT,526)KT,RHO(KT),(TT2(I,KT),TCP(I,KT),TKP(I,KT),THZ(I,KT)
     1,TEP(I,KT),I=1,IT)
      KT=KT+1
      IT=0
      IF(NC) 356,353,353
  356 IF(KT-2) 350,350,710
  710 IF (NDBU) 711,4110,711
  711 I=1
      DO 720 K=1,NDBU
      IT=0
  712 IT=IT+1
      READ(INPUT,571) NC,TTS(IT,I),TCBU(IT,I),TKBU(IT,I)
      IF(NC) 713,712,713
  713 IHI(I+21)=IT
      ILO(I+21)=1
      IR(I+21)=1
      TENT(1,I)=0.
      DO 714 J=2,IT
  714 TENT(J,I)=TENT(J-1,I)+(TCBU(J,I)+TCBU(J-1,I))/2.*(TTS(J,I)-TTS(J-1
     1,I))
      CALL LOOK(21+I,TREF(K),TTS(1,I),TENT(1,I),0,0,0,HSM,DUM,1)
      DO 715 J=1,IT
  715 TENT(J,I)=TENT(J,I)-HSM
      IF(2*K-1) 717,716,717
  716 RHO=RHOC(K)
      GO TO 718
  717 RHO=RHOV(K)
  718 CALL LCOUNT(6+IT,LCT,NPG,RECORD(36))
      L=I+21
      WRITE(KOUT,5260)    L,RHO,(TTS(J,I),TCBU(J,I),TKBU(J,I),TENT(J,I),
     1J=1,IT)
      I=I+1
      IT=0
      IF(NC) 719,353,353
  719 IF(2*K-1) 720,712,720
  720 CONTINUE
 4110 IN=0
      L=0
  411 READ(INPUT,561) KT,RHO(KT),(KMTL(I),I=1,6)
      IF(RHO(KT)) 3550,3550,355
 3550 LL=1
      L=L+1
      JBU=0
      IF(KMTL(1))3553,3553,3549
 3553 WT=FLOAT(L)
      IN=1
```

```
      LL=2
 3559 DO 3554 I=LL,6
      IF(KMTL(I)) 3554,3554,3555
 3555 JBU=JBU+1
      KSV(JBU)=KMTL(I)
      J=KMTL(I)
      NBUFT(J)=L
 3554 CONTINUE
      IF(JBU) 3540,3540,3541
 3541 CALL ORDERI(JBU,KSV)
 3540 IX=0
 3551 IX=IX+1
      READ(INPUT,497) NC,TA(IX,L),F1(IX,L),F2(IX,L)
      IF(NC) 3552,3551,3552
 3552 ILO(31+L)=1
      IHI(31+L)=IX
      IP(31+L)=1
      CALL LCOUNT(5+IN+JBU+4*(1-(L+2)/4),LCT,NPG,RECORD(35))
      IF(L-1) 3546,3546,3547
 3546 WRITE(KOUT,495)
 3547 WRITE(KOUT,496) L
      IF(IN) 3543,3543,3542
 3542 WRITE(KOUT,4971)
 3543 IF(JBU) 3545,3545,3544
 3544 WRITE(KOUT,4981)  (KSV(I),I=1,JBU)
 3545 WRITE(KOUT,494) (TA(I,L),F1(I,L),F2(I,L),I=1,IX)
      IN=0
  494 FORMAT(/25X,1HX,12X,5HF1(X),10X,5HF2(X)//(13X,3(5X,F10.4)))
  495 FORMAT(//7X,67HTABLES OF OPTIONAL MASS-FRACTION FUNCTIONS FOR THER
     1MAL CONDUCTIVITY/25X,23HK = F1(X)*KP + F2(X)*KC)
  496 FORMAT(/23X,21HF-FUNCTION TABLE NO. ,I1,12H ASSIGNED TO)
 4971 FORMAT(34X,13HMAIN MATERIAL)
 4981 FORMAT(28X,24HDECOMPOSING BACK-UP NO. ,I1)
      IF (NC) 411,411,353
  355 IT=IT+1
      READ (INPUT,571) NC,TT2(IT,KT),TCP(IT,KT),TKP(IT,KT)
      IF(NC) 354,355,354
  354 ILO(KT+2)=1
      IHI(KT+2)=ILO(KT+2)+IT-1
      IR(KT+2)=ILO(KT+2)
      CALL LCOUNT(5+IT          ,LCT,NPG,RECORD(35))
  314 WRITE (KOUT,527) KT,AMO(KT),(TT2(I,KT),TCP(I,KT),TKP(I,KT),I=1,IT)
      IT=0
      IF(NC) 411,411,353
C     ---------- PYROLYSIS GAS ENTHALPY
  353 NT1=0
  361 IN=1+NT1
      NT1=8+NT1
      READ  (INPUT,575)NC,(TT1(I),I=IN,NT1),(THG(I),I=IN,NT1)
      IF(NC)361,361,362
  364 NT1=NT1-1
  362 IF(TT1(NT1)) 364,364,365
  365 ILO(2)=1
      IP(2)=1
      IHI(2)=NT1
      CALL LCOUNT(3*((NT1+9)/5),LCT,NPG,RECORD(35))
  316 WRITE (KOUT,532)
      IFN=0
  368 IN=IFN+1
      IFN=MIN0(NT1,IFN+5)
      WRITE (KOUT,531)(TT1(I),I=IN,IFN )
      WRITE (KOUT,533)(THG(I),I=IN,IFN)
      IF(NT1-IFN) 367,367,368
C     ---------- FUNCTIONS OF TIME
  367 NTM=0
      IS=0
      NOPT=0
  371 NTM=NTM+1
      READ(INPUT,577)NC,TTM(NTM),THE(NTM),TBR(NTM),TCM(NTM),TPI(NTM),
     1TAMP(NTM)
      IF(TAMP(NTM))374,375,374
  375 TAMP(NTM)=AMP
  374 II=1
      IF(TCM(NTM))342,342,343
  342 II=2
      IF(THE(NTM)-2.)344,344,343
  344 II=3
  343 IOPT(NTM)=II
      IF(II-IS)345,346,345
  345 NOPT=NOPT+1
      IS=II
  346 IF(NC)371,371,372
  372 ILO(1)=1
      IHI(1)=NTM
      IR(1)=ILO(1)
      CALL LCOUNT (4+3*NOPT+NTM,LCT,NPG,RECORD(35))
      WRITE (KOUT,536)
      IS=0
      DO 3476 I=1,NTM
      II=IOPT(I)
```

```
      IF(II-IS)347,349,347
  347 IS=II
      GO TO (3471,3472,3473),II
 3471 WRITE(KOUT,535)
      GO TO 3474
 3472 WRITE(KOUT,552)
      GO TO 3475
 3473 WRITE(KOUT,556)
      GO TO 3475
  349 GO TO (3474,3475,3475),II
 3474 WRITE(KOUT,536) TTM(I),II,THE(I),TOR(I),TCM(I),TPI(I),TBRP(I)
      GO TO 3476
 3475 WRITE(KOUT,536) TTM(I),II,THE(I),TOR(I)
 3476 CONTINUE
      IF(NC-1) 373,373,743
  373 DO 3731 I=1,NTH
 3731 TPI(I)=ALOG(AMAX1(TPI(I),.000001))
      CALL LCOUNT(2            ,LCT,NPG,RECORD(35))
  328 WRITE (KOUT,537)
C     ----------SURFACE EQUILIBRIUM TABLE
      READ(INPUT,5796) CMMS,VFZ,BREX,NR,NST,NBPF,NFIS,SHELL
      NFIS=NFIS+1
      IF(NST) 2900,2900,2901
 2900 CMM=CMMS
      GO TO 2902
 2901 IF(KNST-777) 2909,2903,2909
 2903 IF(CMM-CMMS) 2907,2905,2907
 2905 WRITE(KOUT,2906)
      CALL LCOUNT(3,LCT,NPG,RECORD(35))
 2906 FORMAT(//10X50HSURFACE TABLES ARE THE SAME AS IN PREVIOUS PROBLEM)
      GO TO 2912
 2907 WRITE(KOUT,2908)
 2908 FORMAT(//10X,72HPREVIOUS SURFACE TABLES CALLED FOR BUT CM/CM RATIO
     1 HAS CHANGED, QUIT JOB//)
      STOP
 2909 WRITE(KOUT,2910)
 2910 FORMAT(//10X,70HPREVIOUS SURFACE TABLES CALLED FOR BUT THIS IS FIR
     1ST PROBLEM, QUIT JOB//)
      STOP
 2902 KNST=777
 2912 IF(NR) 3200,3200,3203
 3201 IF(RSV) 2824,2824,3204
 3200 IF(NREA) 3204,3204,3203
 3203 NR=1
      GO TO 3201
 3204 IF(NST) 3205,3205,3206
 3206 IF(NSEN) 2013,2001,2013
 3205 CONTINUE
      MLS=-1
      NSEN=-1
      IP=1
      IPN=1
      I=1
      IN=1
      J=0
 2000 J=J+1
      IF(NBPF) 20001,20000,20001
20000 READ(INCH,5791) PSV,BMS,TLMC(J,I,IP),TTS(J,I,IP),MLO,TCHEM(J,I,IP)
     1,TSEN(J),JMG,TSURF(J)
      TBPF(J,I,IP)=0.
      GO TO 20002
20001 READ(INCH,5700)PSV,BMS,TLMC(J,I,IP),TTS(J,I,IP),MLO,TCHEM(J,I,IP)
     1,TSEN(J),JMG,TSURF(J),TBPF(J,I,IP)
20002 CONTINUE
 5700 FORMAT(3F8.5,F9.4,F5.3,2F9.3,I2,2I,A4,4X,E10.3)
      IF(JMG) 2017,2017,2021
 2017 TSURF(J)=BLANK
 2021 CONTINUE
      IF(TTS(J,I,IP)) 2003,2032,2001
 2001 TTS(J,I,IP)=TTS(J,I,IP)*1.8
      TCHEM(J,I,IP)=TCHEM(J,I,IP)*1.8
      TSEN(J)=TSEN(J)*1.8
      GO TO 2005
 2003 TTS(J,I,IP)=-TTS(J,I,IP)
 2005 IF(MLS) 2009,2007,2007
 2007 I=MLS
      IF(MLS-MLO) 2024,2011,2024
 2009 MLS=MLO
 2011 IF(NSEN) 2002,2020,2020
 2002 IF(JMG) 2000,2004,2004
 2004 NSEN=J-1
      ISEN(IP)=NSEN
      IF(NSEN-1) 2020,2020,2008
 2008 DO 2006 L=1,NSEN
      TTSEN(L,IP)=TTS(L,1,IP)
      TZSEN(L,IP)=TCHEM(L,1,IP)
 2006 THSEN(L,IP)=TSEN(L)
      CALL SLOPE(NSEN,TTSEN(1,IP),THSEN(1,IP),TCPSEN(1,IP))
      CALL SLOPE(NSEN,TTSEN(1,IP),TZSEN(1,IP),TCZSEN(1,IP))
      LLL=(NSEN-1)/3+1
```

```
      IF(IP-1)20137,2013,20137
 2013 CALL LCOUNT(11+2*NN,LCT    ,NPG,RECORD(35))
      WRITE (KOUT,5306)
      WRITE (KOUT,5797) CNN,WLG,VFZ
      GO TO(20130,20131),NFIS
20131 WRITE(KOUT,20132)
20132 FORMAT(6X,66HPRESSURE MODEL USED FOR SURFACE ENERGY TERMS AND BLOWI
     1NG CORRECTION)
      GO TO 20133
20130 WRITE(KOUT,20612)
20133 CONTINUE
      IF (NN) 2018,2016,2016
 2016 WRITE (KOUT,5799) BREX
      GO TO 2015
 2018 WRITE (KOUT,5798)
 2015 IF(SWELL) 20134,20135,20134
20135 WRITE(KOUT,20136)
20136 FORMAT(6X,45HNO CHAR SWELL CORRECTION ON SURFACE RECESSION)
      GO TO 20137
20134 WRITE(KOUT,20138) SWELL
20138 FORMAT(6X,12HCHAR SWELL =F6.4,1X)6H* CHAR THICKNESS)
20137 IF(NST) 20140,20140,1390
20140 CALL LCOUNT(LLL+6,LCT,NPG,RECORD(35))
      WRITE(KOUT,5792)PSV
      DO 2019 LL=1,LLL
 2019 WRITE(KOUT,5798) (TTSEN(L,IP),THSEN(L,IP),L=LL,NSEN,LLL)
      GO TO 2062
 2020 NSEN=0
      IX=3
      IF(CNN-1.) 2024,2022,2024
 2022 IX=2
      IF(WLG) 2024,2026,2024
 2024 WRITE (KOUT,5793) IX
      STOP
 2026 IF(IP-1) 2062,2061,2062
 2028 IF(TTS(J,1,IP)) 2029,2032,2029
 2029 IF(PSV-TPR(IP)) 2032,2030,2032
 2030 IF(DNS-TNG(1,IP)) 2034,2000,2034
 2032 IPN=IP+1
      NNG(IP)=1
      IN=0
      NSEN=-NSEN
 2034 IN=IN+1
      NN1(1,IP)=J-1
      NNC=J-1
      CALL UNDERU(NNC,TLNC(1,1,IP),IZ)
      IF(NNFF) 3052,3052,4052
 4052 CALL SEQUAS(NNC,IZ,TTS(1,1,IP),TCHEM(1,1,IP),TSEN(1),TSURF(1),TMPF
     1(1,1,IP))
      GO TO 4053
 3052 CONTINUE
      CALL SEQUA(NNC,IZ,TTS(1,1,IP),TCHEM(1,1,IP),TSEN(1),TSURF(1))
 4053 CONTINUE
      IA=0
      IG=1
      NPG=TNG(1,IP)
      NLO(1,IP)=1
      KN1(1,IP)=1
      DO 2052 K=1,NNC
      WP=WPG+TLNC(K,1,IP)
      GO TO(20340,20341),NFIS
20341 HGA=TSEN(K)
      GO TO 20342
20340 CONTINUE
      CALL LOOK(2,TTS(K,1,IP),T11,TNG,0,0,0,HGA,CT1,1)
      HGA=HGA+DELHG
20342 CONTINUE
      CALL LOOK(6,TTS(K,1,IP),T12(1,2),TNZ(1,2),0,0,0,HCH,CT2,1)
      HCH=HCH+DH2
      IF(NSEN) 2038,2036,2038
 2036 HE=TCHEM(K,1,IP)
      TCHEM(K,1,IP)=BP*HGA+TLNC(K,1,IP)*HCH-BP*TSEN(K)
      GO TO 2040
 2038 CALL UALE(1,TTS(K,1,IP),HZ,ISEN(IP),TTSEN(1,IP),TZSEN(1,IP),TCZSEN
     1(1,IP))
      CALL UALE(1,TTS(K,1,IP),HE,ISEN(IP),TTSEN(1,IP),THSEN(1,IP),TCPSEN
     1(1,IP))
      TCHEM(K,1,IP)=BPG*HGA+TLNC(K,1,IP)*HCH-BP*TSEN(K)+HZ-TCHEM(K,1,IP)
 2040 TSEN(K)=HE
      IF(TSURF(K)-BLANK) 2044,2042,2044
 2042 NLO(1,IP)=K+1
      IF(IG+IA-1) 2044,2044,2046
 2044 IA=1
 2046 IF(K-IN) 2052,2052,2048
 2048 IF(TTS(K,1,IP)-TTS(K-1,1,IP)) 2050,2050,2051
 2050 IG=NNC
      GO TO 2052
 2051 KN1(1,IP)=K
 2052 CONTINUE
      LLL=(NNC-1)/2+1
```

```
      CALL LCOUNT(LLL+6        ,LCT,NPG,RECORD(35))                     INPOUT721
      WRITE(KOUT,5795)TNG(I,IP),TPR(IP),((TTS(L,I,IP),TLMC(L,I,IP),TCHEMINPOUT722
     1(L,I,IP),TSURF(L),L=LL,NMC,LLL),LL=1,LLL)                         INPOUT723
      DO 2056 K=1,NMC                                                   INPOUT724
      TCHEM(K,I,IP)=CNV*TCHEM(K,I,IP)-TSEN(K)                           INPOUT725
      IF(K-NLO(I,IP)) 2056,2054,2054                                    INPOUT726
 2054 TLMC(K,I,IP)=ALOG(AMAX1(TLMC(K,I,IP),.00001))                     INPOUT727
      IF(NBPF) 2056,2056,3056                                           INPOUT728
 3056 TBPF(K,I,IP)=ALOG(AMAX1(TBPF(K,I,IP),1.E-12))                     INPOUT729
 2056 CONTINUE                                                          INPOUT730
      CALL SSWTCH(1,KKSW)                                               INPOUT731
      GO TO (730,731),KKSW                                              INPOUT732
  730 CALL LCOUNT(LLL+6,LCT,NPG,RECORD(35))                             INPOUT733
      WRITE(KOUT,5795)TNG(I,IP),TPR(IP),((TTS(L,I,IP),TLMC(L,I,IP),TCHEMINPOUT734
     1(L,I,IP),TSEN(L) ,L=LL,NMC,LLL),LL=1,LLL)                         INPOUT735
      IF(NBPF) 731,731,6016                                             INPOUT736
 6016 CALL LCOUNT(3+NMC,LCT,NPG,RECORD(35))                             INPOUT737
      WRITE(KOUT,6017) (TBPF(L,I,IP),L=1,NMC)                           INPOUT738
 6017 FORMAT(/10X,16HLOG B PRIME FAIL//(10X,E12.3))                     INPOUT739
  731 CONTINUE                                                          INPOUT740
      IF(TTS(J,I,IP)) 2062,2070,2062                                    INPOUT741
 2061 CALL LCOUNT(10+2*NR,LCT,NPG,RECORD(35))                           INPOUT742
      WRITE (KOUT,530)                                                  INPOUT743
      WRITE (KOUT,5796) WFZ                                             INPOUT744
      GO TO (20610,20611),NFIS                                          INPOUT745
20611 WRITE(KOUT,20132)                                                 INPOUT746
      GO TO 20613                                                       INPOUT747
20610 WRITE(KOUT,20612)                                                 INPOUT748
20612 FORMAT(6X,36HFISSURE MODEL NOT USED FOR GAS TERMS)                INPOUT749
20613 CONTINUE                                                          INPOUT750
      IF (NH) 2063,2063,2064                                            INPOUT751
 2064 WRITE(KOUT,5799) BREX                                             INPOUT752
      GO TO 2715                                                        INPOUT753
 2063 WRITE (KOUT,5798)                                                 INPOUT754
 2715 IF(SWELL) 2734,2735,2734                                          INPOUT755
 2735 WRITE(KOUT,20136)                                                 INPOUT756
      GO TO 2737                                                        INPOUT757
 2734 WRITE(KOUT,20134) SWELL                                           INPOUT758
 2737 IF(NSI) 2062,2062,1390                                            INPOUT759
 2062 TPR(IPN)=PSV                                                      INPOUT760
      TNG(IN,IPN)=ONS                                                   INPOUT761
      TLMC(1,IN,IPN)=TLMC(J,I,IP)                                       INPOUT762
      TBPF(1,IN,IPN)=TBPF(J,I,IP)                                       INPOUT763
      TTS (1,IN,IPN)=TTS (J,I,IP)                                       INPOUT764
      TCHEM(1,IN,IPN)=TCHEM(J,I,IP)                                     INPOUT765
      TSURF(1)=TSURF(J)                                                 INPOUT766
      TSEN(1)=TSEN(J)                                                   INPOUT767
      J=1                                                               INPOUT768
      I=IN                                                              INPOUT769
      IP=IPN                                                            INPOUT770
      GO TO 2000                                                        INPOUT771
 2070 NPR=IP                                                            INPOUT772
      IR(12)=1                                                          INPOUT773
      ILO(12)=1                                                         INPOUT774
      IHI(12)=1                                                         INPOUT775
      DO 2072 I=1,IP                                                    INPOUT776
 2072 TPR(I)=ALOG(TPR(I))                                               INPOUT777
      IR(13)=1                                                          INPOUT778
      IHI(13)=NPR                                                       INPOUT779
      ILO(13)=1                                                         INPOUT780
  743 IF(NBDU) 740,1390,740                                             INPOUT781
  740 CALL SSWTCH(3,KKSW)                                               INPOUT782
      GO TO (741,1390),KKSW                                             INPOUT783
  741 WRITE(KOUT,742) (NFI(J), J=1,NBDU)                                INPOUT784
      WRITE(KOUT,742) (NLA(J), J=1,NBDU)                                INPOUT785
      WRITE(KOUT,742) NBDU,NBD2                                         INPOUT786
      LU=NBDU*2+21                                                      INPOUT787
      WRITE(KOUT,742) (IHI(J),ILO(J),IR(J),J=22,LU)                     INPOUT788
  742 FORMAT(6I5)                                                       INPOUT789
 1390 RETURN                                                            INPOUT790
      END                                                               INPOUT791
```

```
      SUBROUTINE THERMS(NISO,TU,DEP,NR,CN,RAT)
      COMMON KOUT,IEA,GEN,VR
      COMMON IHI(30),ILO(30),IR(30),TT2(30,10),TCP(30,10),TKP(30,10),THZ
     1(30,10),TEP(30,10),TTH(30),THE(30),TBR(30),TCN(30),TT1(30),THG(30)
     2,DH12(2),RECOND(30),SO(70)
      COMMON MHO(10)
      COMMON MATL( 50),DEL( 51),TA( 51),H(50),RC(50),RA( 50),
     1AREA( 50),EMA( 50),RAV( 50)
      COMMON RDA( 500),RDB( 500),RDC( 500)
      COMMON TPR(3),NMB,IDIOT(2),THG(15,3),ALO(15,3),AHI(15,3),
     1AHI(15,3),TTSEN(25,3),THSEN(25,3),TCPSEN(25,3),TLAC(25,15,3),
     2TSEN(3),TP1(30),TTS(25,15,3),TCHEM(25,15,3),VF2,CNN
      COMMON TBPF(25,15,3)
      COMMON NPR
      COMMON LCT,NPG,II,NBH,NUMN,NL,DELHG,BELM,NFT,RHORA,RHORB,RHORC,TRA
     1CA,TRACB,TRACC,RHODA,RHODB,RHODC,EA,EB,EC,BA,BB,BC,PSIA,PSIB,PSIC,
     2TRACM,PET,PETC,RSV,ETA,DTPR3,DTPR2,DTPR1,TPR3,TPR2,TKZRO,THFIN,WT,
     3TMHT,GAMA,OMG,MU,FJFM,FJFS,JF,JFMP,JFM,INPUT,      DTMIN,BMP,NCONV,
     4EPSW,TRES,INCH,UTHD
      COMMON NN,NI,NDI
      DIMENSION RAISO(51),TATMM(51),TO(10),DEP(10,5),NISO(5),RK(1),CN(1)
      DIMENSION RAT(51)
      ISO=0
      RAISO(1)=RA(NL)
      TATMM(1)=TA(NL)
      DO 200 I=NBH,NUMN
      ISO=ISO+1
      RAISO(ISO+1)=RA(I)
  200 TATMM(ISO+1)=TA(I)
      TATMM(ISO+2 )=TA(NUMN+1)
      IF(ND) 202,202,201
  201 DO 260 I=1,ND
      DIS2=0.
      IF(SO(I)-RA(NL)) 260,260,222
  222 DO 300 K=1,ISO
      IF(SO(I)-RAISO(K+1)) 354,300,300
  300 CONTINUE
      K=ISO+1
  354 IF(K-1) 260,227,221
  227 K=NL
      L=NBH
      M=NL
      GO TO 223
  221 K=NBH+K-2
      L=K+1
      M=K
  223 IF(ABS(1.-SO(I)/(RA(K)+DEL(K)*6.))-1.E-5) 252,252,251
  251 IF(ABS(SO(I)/(RA(K)+DEL(K)*6.))-1.) 224,224,225
  252 DIS2=RC(K)/2.*CN(K)
  224 DIS=(SO(I)-RA(K))/12.
      GO TO 226
  225 IF(K-NUMN)2251,2252,2252
 2252 TO(I)=TRES
      GO TO 260
 2251 DIS=(RA(L)-SO(I))/12.
      J=K
      K=L
      L=J
  226 TO(I)=TA(K)+(TA(L)-TA(K))/(0.5*(RAT(K)+RAT(L))+RC(M)/RK(M))*
     1 DIS/(CN(K)*RK(K))*(1.+DIS2/DIS)
  260 CONTINUE
  202 IF(NI) 203,203,204
  204 DO 210 I=1,NI
      NISO(I)=0
      DO 210 J=1,5
      DEP(I,J)=0.
  210 CONTINUE
      ISO=ISO+1
      DO 2100 I=1,NI
      N=0
      ISOT=ND+I
      T=SO(ISOT)
      DO 211 J=1,ISO
      IPLS=0
      IMNS=0
      IF(T-TATMM(J)) 100,102,101
  100 IMNS=1
      GO TO 102
  101 IPLS=1
  102 IF(T-TATMM(J+1))103,211,104
  103 IMNS=IMNS+1
      GO TO 105
  104 IPLS=IPLS+1
  105 IF(IPLS*IMNS) 212,211,212
  212 N=N+1
      IF(J-1) 211,213,214
  213 K=NL
      L=NBH
      GO TO 220
  214 K=NBH+J-2
```

```
      L=K+1
      IF(K-NUMN) 215,220,220
  215 IF(MATL(K)-MATL(K+1)) 220,216,220
  220 QI=(TA(K)-TA(L))/(0.5*(RAT(K)+RAT(L))+RC(K)/RK(K))
      TIU=TA(K)-0.5*RAT(K)*QI
      TIL=TIU-RC(K)/RK(K)*QI
      DO 499 N=1,2
      IPLS=0
      IMNS=0
      GO TO (401,402),N
  401 T1=TA(K)
      T2=TIU
      GO TO 403
  402 T1=TIU
      T2=TIL
  403 IF(T-T1) 351,500,352
  351 IMNS=1
      GO TO 353
  352 IPLS=1
  353 IF(T-T2)357,500,355
  357 IMNS=IMNS+1
      GO TO 356
  355 IPLS=IPLS+1
  356 IF(IPLS*IMNS) 500,499,500
  499 CONTINUE
      N=3
  500 GO TO (2202,2204,2203),N
 2204 DEP(I,N)=RA(K)+0.*DEL(K)
      GO TO 2112
  216 DEN=TA(L)-TA(K)
      X2=TA(L)-T
      X1=TA(K)-T
      DEP(I,N)=(RA(K)*X2-RA(L)*X1)/DEN
      GO TO 2112
 2202 DEN=TIU-TA(K)
      X1=TA(K)-T
      DEP(I,N)=RA(K)-0.*DEL(K)*X1/DEN
      GO TO 2112
 2203 IF(K-NUMN) 2205,2204,2204
 2205 DEN=TA(L)-TIL
      X2=TA(L)-T
      DEP(I,N)=RA(L)-0.*DEL(L)*X2/DEN
 2112 TO(ISOT)=0.
  211 CONTINUE
      IF(N-1) 2100,2101,2102
 2101 NISO(I)=0
      TO(ISOT)=DEP(I,N)
      GO TO 2100
 2102 CONTINUE
      NISO(I)=N
 2100 CONTINUE
  203 RETURN
      END
```

```
C UTILITY ROUTINE LCOUNT -- COUNTS,TITLES, AND NUMBERS EACH PAGE
      SUBROUTINE LCOUNT (J,LCT,NPG,R)
      COMMON KOUT
      DIMENSION R(2)
  551 FORMAT(1H1,10X,65HAEROTHERM CHARRING MATERIAL THERMAL RESPONSE AND A
     1BLATION PROGRAM/73X,4HPAGE I3/1H 67X,2A6)
      I=J
      IF(I) 2,2,3
    2 I=-I
      GO TO 4
    3 LCT=LCT-I
      IF (LCT) 4,5,5
    4 NPG=NPG+1
      LCT=60-I
      WRITE (KOUT,551) NPG,R
    5 RETURN
      END
```

```
C UTILITY ROUTINE LOOK  -- LOOKS UP AND LINEARLY INTERPOLATES WITHIN
C      TABLES HAVING ONE INDEPENDENT AND UP TO FOUR DEPENDENT VARIABLES
      SUBROUTINE LOOK(II,AL,X,A,B,C,E,Y,D,IDN)
      COMMON KOUT,IEX,DEN,VR
      COMMON IHI(30),ILO(30),IR(30)
      DIMENSION  X(1),Y(1),D(1)
      DIMENSION A(1),B(1),C(1),E(1)
      IM=IHI(II)
      IL=ILO(II)
      IEX=0
      IF(X(IM)-X(IL)) 30,30,29
   30 IEX=1
      IF (AL-X(IM)) 3,2,31
   31 IF (AL-X(IL)) 6,5,4
   29 IF(AL-X(IM))1,2,3
    1 IF(AL-X(IL))4,5,6
    6 I=IR(II)
      I=MIN0(I,IM)
      I=MAX0(I,IL)
      IS=1
      IT=1
      GO TO 8
   11 I=I+1
      IS=0
    8 IF(IEX) 28,28,38
   28 IF(AL-X(I)) 7,10,9
   38 IF(AL-X(I)) 9,10,7
    7 I=I-1
      IT=0
      IF(IS)10,10,8
    9 IF(IT)10,10,11
    3 IEX=3
    2 I=IM-1
      GO TO 10
    4 IEX=2
    5 I=IL
   10 DEN=X(I+1)-X(I)
      IR(II)=I
      VR=AL-X(I)
      IF(IDN) 13,13,14
   14 GO TO (21,22,23,24),IDN
   24 Y(4)=E(I)
      D(4)=E(I+1)-E(I)
   23 Y(3)=C(I)
      D(3)=C(I+1)-C(I)
   22 Y(2)=B(I)
      D(2)=B(I+1)-B(I)
   21 Y(1)=A(I)
      D(1)=A(I+1)-A(I)
      DO 12  J=1,IDN
   20 D(J)=D(J)/DEN
   12 Y(J)=Y(J)+D(J)*VR
   13 VR=VR/DEN
      RETURN
      END
```

```
C UTILITY ROUTINE OGLE  -- EVALUATES AN ARRAY OF VALUES OF A DEPENDENT
C      VARIABLE FROM AN ARRAY OF VALUES OF AN INDEPENDENT VARIABLE USING
C      A CUBIC CURVE FIT FOUND FROM TABULAR VALUES AND SLOPES OF
C      SURROUNDING POINTS
       SUBROUTINE OGLE(N,XAM,PRM,NUMX,X,P,EM)
       DIMENSION XAM(1),X(1),P(1),EM(1),PRM(1),DPDIN(1)
       XDIF=X(NUMX)-X(1)
       IS=1
     2 DO 600 J=1,N
       XA=XAM(J)
    59 IO=1
       IT=1
    61 IF(XDIF) 72,60,71
    71 IF(XA-X(IS)) 62,63,64
    72 IF(X(IS)-XA) 62,63,64
    62 IF(IS-1)671,671,68
    68 IS=IS-1
       IT=2
       GO TO (61,66),IO
   672 IS=NUMX
   671 I=IS
       H=0.
       DPDI=EM(I)
       GO TO 67
    63 PR=P(IS)
       DPDI=EM(IS)
       GO TO 601
    64 IS=IS+1
       IF(IS-NUMX)69,69 ,672
    69 IO=2
       GO TO (61,65),IT
    65 IS=IS-1
    66 I=IS
       G=(((P(I+1)-P(I))/(X(I+1)-X(I)))-EM(I))/(X(I+1)-X(I))
       F=(((EM(I+1)-EM(I))/(X(I+1)-X(I)))-2.*G)/(X(I+1)-X(I))
       H=(F*(XA-X(I+1))+G)*(XA-X(I))
       DPDI=(H+H+EM(I)+F*(XA-X(I))*(XA-X(I)))
    67 PR=(H+EM(I))*(XA-X(I))+P(I)
   601 CONTINUE
       PRM(J)=PR
   600 CONTINUE
    60 CONTINUE
     4 RETURN
       END
```

```
C UTILITY ROUTINE ORDERD -- ROUTINE TO REORDER A FLOATING POINT ARRAY
C       WITH SPECIAL FEATURES FOR ORDERING SURFACE THERMOCHEMISTRY TABLES
      SUBROUTINE ORDERD (NX,X1,I1)
      DIMENSION X1(1),I1(1)
      DIMENSION LS(20)
      NN=IABS(NX)
      LS(1)=0
      LS(2)=1
      LS(3)=2
      LI=3
      I1(1)=1
      DO 1 N=2,NN
      I1(N)=N
      L=LS(LI)
      LA=LI
      J=N
      X1C=X1(J)
      I1C=I1(J)
      J=J-L
      IF(J) 31,31,34
   34 LI=LI+1
      LS(LI)=L+L
      GO TO 29
   33 LA=LA-1
      L=LS(LA)
      IF(L) 3,3,41
   41 J=J-L
   32 IF(J) 31,31,29
   31 LA=LA-1
      L=LS(LA)
      J=J+L
      IF(L) 4,4,32
   30 LA=LA-1
      L=LS(LA)
      IF(L) 4,4,42
   42 J=J+L
   29 IF(NX) 229,129,129
  229 IF(X1C-X1(J)) 30,53,33
  129 IF(X1(J)-X1C) 30,53,33
   53 J=1
      GO TO 3
    4 J=J+1
    3 M=N-1
      MM=M
      DO 2 K=J,MM
      X1(M+1)=X1(M)
      I1(M+1)=I1(M
    2 M=M-1
      I1(J)=I1C
    1 X1(J)=X1C
      RETURN
      END
```

```
C UTILITY ROUTINE ORDERI -- ROUTINE TO REORDER INTEGER ARRAYS
      SUBROUTINE ORDERI(NX,IPH)
      DIMENSION IPH(70)
      N=NX
      IF(NX) 9,6,1
    9 N=-N
    1 IF(N-1)6,6,2
    2 K = 0
      DO 4 J=2,N
      IF(NX)8,7,7
    7 IF (IPH(J-1)-IPH(J)) 4,4,3
    8 IF (IPH(J-1)-IPH(J)) 3,3,4
    3 IT = IPH(J-1)
      IPH(J-1) = IPH(J)
      IPH(J) = IT
      K = 1
    4 CONTINUE
      IF (K) 6,6,2
    6 RETURN
      END
```

```
C UTILITY ROUTINE SEQUA -- REORDERS UP TO FOUR DEPENDENT VARIABLE
C     ARRAYS BASED ON THE RESULTS OF ORDERD CALL
      SUBROUTINE SEQUA(N,L,A,B,C,D)
      DIMENSION A(1),B(1),C(1),D(1),L(1)
      IS=0
      DO 30 II=1,N
      I=II
   21 J=L(I)
      L(I)=I
      IF(J-I) 22,30,22
   22 IF(IS) 25,23,25
   23 SA=A(I)
      SB=B(I)
      SC=C(I)
      SD=D(I)
      IS=I
   26 A(I)=A(J)
      B(I)=B(J)
      C(I)=C(J)
      D(I)=D(J)
      I=J
      GO TO 21
   25 IF(IS-J) 26,28,26
   28 IS=0
      A(I)=SA
      B(I)=SB
      C(I)=SC
      D(I)=SD
   30 CONTINUE
      RETURN
      END
```

```
C UTILITY ROUTINE SEQUAS -- REORDERS UP TO FIVE DEPENDENT VARIABLE
C     ARRAYS BASED ON THE RESULTS OF ORDERD CALL
      SUBROUTINE SEQUAS(N,L,A,B,C,D,E)
      DIMENSION A(1),B(1),C(1),D(1),L(1)
      DIMENSION E(1)
      IS=0
      DO 30 II=1,N
      I=II
   21 J=L(I)
      L(I)=I
      IF(J-I) 22,30,22
   22 IF(IS) 25,23,25
   23 SA=A(I)
      SB=B(I)
      SC=C(I)
      SD=D(I)
      SE=E(I)
      IS=I
   26 A(I)=A(J)
      B(I)=B(J)
      C(I)=C(J)
      D(I)=D(J)
      E(I)=E(J)
      I=J
      GO TO 21
   25 IF(IS-J) 26,28,26
   28 IS=0
      A(I)=SA
      B(I)=SB
      C(I)=SC
      D(I)=SD
      E(I)=SE
   30 CONTINUE
      RETURN
      END
```

```
C UTILITY ROUTINE SLOPU -- GENERATES SLOPES OF DEPENDENT VARIABLES
C     BASED ON QUADRATIC FITS THROUGH THREE SUCCESSIVE TABLE POINTS
      SUBROUTINE SLOPU(NUMX,X,P,EM)
C     SLOPE EVALUATION ROUTINE
C
       DIMENSION X(1), P(1), FM(1), Z(1)
   30 EM(2) = ( P(2) - P(1) ) / ( X(2) - X(1) )
      EM(1) = EM(2)
      Z(1)=0.0
      QC = EM(1)
      DO 36 I = 1 , NUMX
      IPO = I + 1
      IPT = I + 2
      IT = IPO - NUMX
      IF (IT) 33 , 31 , 32
   31 QB=QC
      GO TO 41
   32 GO TO 40
   33 XOT = X(I) - X(IPO)
      XTT = X(IPO) - X(IPT)
      XTO = X(IPT) - X(I)
      AA = P(I) / ( XOT * XTO )
      XOTT=XOT*XTT
   37 AB=P(I+1)/XOTT
      AC = P(IPT) / ( XTT * XTO )
      AAA = AA * XTT
      ABB = AB * XTO
      ACC = AC * XOT
      QA = QC
      QB = EM(I)
      QC = EM (IPO)
      EM(IPO) = AB * (XOT - XTT) + ACC - AAA
      EM(IPT) = AC * (XTT - XTO) + AAA - ABB
      EM(I)=   AA * (XTO - XOT) + ABB - ACC
   34 QE = EM(I)
      IF(I-2) 36,41,35
   35 EM(I) = ( QE + QA ) /2.
   41 EM(I) = (EM(I) + QB ) /2.
   40 XO=X(I)-X(I-1)
   36 CONTINUE
      RETURN
      END
```

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13. ABSTRACT

This two-volume report describes a Fortran IV computer code which computes the transient thermal and ablation response of a charring insulation material structure. The program is for one-dimensional bodies, but can treat a variety of shapes, including planes, cylinders, spheres, and more general thermal "stream tube" bodies. The program can treat complex systems including a main ablating material, several charring back-up materials, and a multiple non-charring material back-up structure.

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Equilibrium computer codes						
Fortran computer program						
Heat transfer						
Heterogeneous chemistry						
Resin degradation						
Rocket nozzle analysis						
Solid propellant						
Surface reactions						
Thermal decomposition						
Thermal response						
Thermochemistry						
User's Manual (Computer Code)						